PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

SEPTEMBER, 1939

A. PRESCOTT FOLWELL, Editor — VOL. 70. NO. 9 — W. A. HARDENBERGH, Asso. Editor

Contents

TIMEWASTERS

Ikey and Mikey had a wild trip last month. Says Mr. Rowntree: "I am no good at figures; I usually drive my men with a pick handle, but I'll guess that Ikey catches up with Mikey after Mikey travels 617.31928 miles and before Ikey travels 617.32620 miles." Yes, after 9 hrs., 54 min. and 32.7 seconds, Ikey is back on the job. Mr. Rowntree says 9 hrs. and 54.58359375 mins.; and 2 hours more for Mikey. Oh, yes, at that time Mikey is idling along at 74 mph. and Ikey is high-balling it at 85 mph. Where were the cops?

Mr. Derry says the best way to butcher that block of wood is to cut off the ¾-inch excess, and then go to it, arriving with 24 blocks in all.

Wide Open Spaces:

There was a square field enclosed with a board fence. Each board is 11 feet long and the fence is four boards high. The farmer asked the engineer to tell him how many acres there were in the field. The engineer said: "There are as many acres in the field as there are boards in the fence." Yes, boys, it's quite a field. *EBG Pioneer.*

Getting Ready for College:

A trunk will hold 32 pounds of clothes or 96 pounds of books. What will it weigh when packed full of clothes and books, if the weight of the books amounts to 30% of the whole? *Thanks, Mr. Derry.* W. A. H.

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OF WATER PURIFICATION

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When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 62 to 65

PUBLIC WORKS Magazine • • SEPTEMBER, 1939

Vol. 70. No. 9

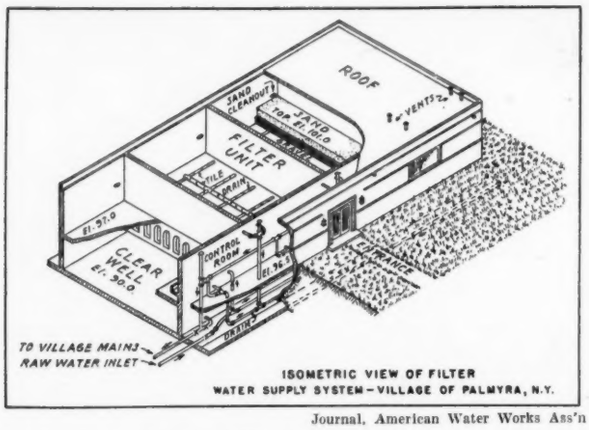
The interior of Ann Arbor's filter plant, showing arrangement of gauges and controls and attractive appearance.

Progress and Developments in Water Purification

DOLLAR values of the benefits resulting from water treatment have been calculated by Shaw and Chase[1]. They estimate that removal of danger from typhoid fever is worth $20,000 per death, or $80 per million gallons of water filtered while the cost of filtration by slow sand filters is $1 to $6.65 per mg., and by rapid sand filters (including pumping) $2.79 to $16.78. The value assigned to the removal of color is 55 cents per mg., per ppm over 10 ppm, while the cost of removal runs from 10 cents to $2.38. The removal of turbidity over 5 ppm., has a value of $1.10 per mg., while the cost is 7 cents to $4.38. The removal of hardness over 100 ppm has a money value of 41 cents per mg., while the cost is 8 to 33 cents. The values are estimated; the costs are based on those at a number of plants. The higher costs occur where the amount to be removed is small.

The remarkable decline in waterborne typhoid, and in the other diseases that are spread by water, during the past 20 years is proof that good water supplies are worth what they cost from the health viewpoint alone, and without consideration of the additional values that result from having an adequate supply of soft, safe water free from color or taste. But equipment alone is not sufficient; trained and capable personnel is required. "Although the remarkable decline in typhoid fever death rates," say Gorman and Wolman[2], "during the period 1920-36 is most encouraging, it should not lull the public and especially water works and public health officials into a false sense of security, for during this period many large and disastrous water-borne outbreaks occurred which were easily preventable if more strict supervision had been given to eliminate known and potential pollutional hazards."

The Illinois Health Messenger[3] reports a typhoid outbreak which illustrates one of the many ways in which dangerous contamination can occur. In the summer of 1938, in a suburb of Chicago, road improvement necessitated the moving of a hydrant. At that particular point the sewer main overlaid the water main; in



Journal, American Water Works Ass'n

Slow sand filter at Palmyra, N. Y.

the process of construction, both were cut and both were open simultaneously for a short period. Although pumps were used to carry off the accumulated sewage from the sump, 5 cases of typhoid developed within two weeks. While no proof of the source of typhoid was available, the evidence points strongly to contaminated water. Not only should water department employees be present whenever a water main is cut or moved for any reason, but such employees ought to be trained in elementary sanitation. The Connecticut State Sanitary Code was recently amended to require notification of local and state health officers, by "telephone, messenger or other rapid means of communication" when a supply is interrupted or the source of supply damaged so as to "impair the quality or sufficiency of the supply."

Storms and hurricanes, floods and other disasters have often affected water supplies, and plans for safeguarding the quality and for providing a sufficient quantity for emergencies should be prepared in advance. Essential elements may include: An auxiliary and independent source of power for pumping and operating essential purification units; provision of elevated storage; adequate dams and spillways; plant location to prevent or minimize damage; plant protection; excess filter area to handle unusually bad waters; duplicate chlorinating equipment; and even an extra portable chlorinator.

Purification Plant Construction

During the past few years, most water works construction has been carried on through the PWA and the WPA; the records of these organizations are not up to date, so far as determining how many such plants have been constructed; but there have been a great many, and most of them have been needed. Of the WPA-PWA plants, many were small plants and were built to a fairly well standardized design. Rapid sand filters, of course, have practically superseded all other types, but it is of interest to note that at least three slow sand filters have been built in the past three or four years — Palmyra, N. Y., and Greenfield and Northborough, Mass. Among the reasons that influenced the selection of this type of filter were the lower operating costs, the need for less skilled operating attention, less serious results from operating inattention, and elimination of the problem of wash water disposal. First cost is generally not lower than that of rapid sand filters.

In California mountain sections, the water is turbid only occasionally and for the greater part of the time can be used with no more than chlorination; in several places the water is treated when turbid by coagulation and settling, without filtration. Turbidity is reduced generally to below 5 ppm., but occasionally reaches 20 ppm. in some supplies.

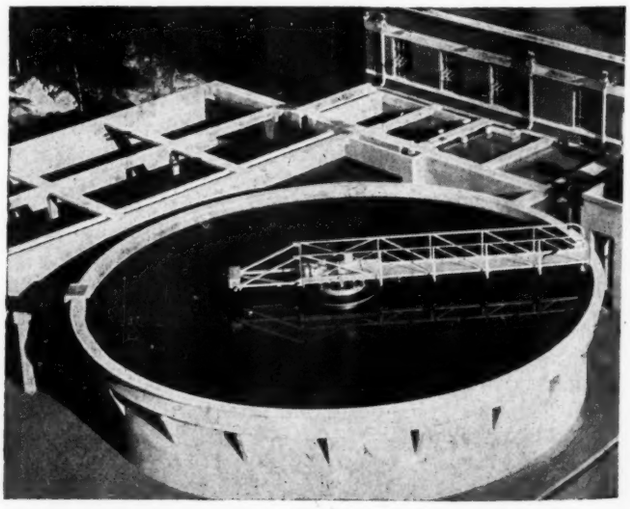
New Ideas in Filtration

Filtering Materials.—Filter materials should be selected for their ability to safeguard public health, and selection should be based on the consideration of the effluent quality during the worst conditions of loading. Experience generally indicates that (1) filtration takes place within as well as at the top of the filter. (2) Filter runs vary as the 2.15 power of the effective size of the filter media. (3) The Baylis method of effective size determination gives excellent correlation of filter runs with filter material size. (4) Filter runs vary with the reciprocal of the 1.5 power of the rate of filtration and (5) with the cube of the filter material porosity. (6) Runs on anthracite coal filters are longer than on sand with equally good or better effluent. Hudson[4] finds that filter runs vary with the 3.8 power of the filter material porosity, and not with the cube, as reported by previous literature; also that glass tube filters are reliable indicators as guides to plant operation.

Operation Details.—Manganese in the water often coats the grains of sand or the gravel in the supporting layer. At Larchmont, N. Y., the coating on the sand grains acted as a catalytic agent, reducing the manganese in the water from 0.8 or 1.0 ppm. to about 0.20 ppm. The coated sand was therefore not removed, since the coating did not interfere with sand washing. The Pennsylvania Water Co., however, experienced serious trouble with manganese coatings on the gravel layer, cementation occurring to such an extent as to prevent proper washing. A 1% caustic soda solution proved effective in removing the manganese, and also iron and alumina coatings. A low pH treatment removed 76.5% of the deposit from the sand; and on anthrafilt, 99% was removed. A manganese dioxide coating on the sand grains helped to prevent deposits on the gravel.

Wash water disposal offers a problem at some plants. At Salem-Beverly, Mass., this is discharged into a series of three lagoons in a swamp nearby. The effluent from the final lagoon will flow into the lake, but after 16 months of operation, it has not yet filled due to evaporation and seepage losses. Sludge from the coagulation basins is also discharged into these lagoons; this occasioned some odor and there was a considerable algae growth, but the water in the final lagoon appears to be of as good quality as that in the lake.

Sand expansion at Allentown, Pa., is measured by



Settling tank of water softening plant, St. Augustine, Florida.

Another plant interior: a Spaulding precipitator is shown at the rear

means of a float, counterweight and indicator. The counterweight apparently should weigh about 87% as much as the float, depending on the kind of filter media. Water temperature and depth apparently do not affect the accuracy. The float is in the shape of a cone, and to prevent filter material from lodging on the sides, a slope of 45° is necessary for sand and about 52° for anthracite.

Down at the Baltimore Burnt Mills plant, the sight well was first painted white, but this soon became discolored; and when a second unit was built, this was lined with white tile, which proved so satisfactory that the first basin was then lined with the same material. A bottom lining of alternating black and white tile gives best clarity determination, and permits detecting turbidities of 0.2 to 0.3 ppm.

Another device for the operator is the turbidicator used at the Moffat filter plant at Denver, Colo. A photo-cell unit is employed. An increase in turbidity closes a gong and red light circuit; a decrease closes a gong and green light circuit. The operator is thus notified that adjustment is needed in the dosage. In this connection, a manufacturer is bringing out a turbidimeter which will record automatically turbidity, by 2 ppm. steps, and will record the readings and operate two or three devices, as desired. The Denver device is being considered for obtaining automatic washing of filters if turbidity appears in the filter effluent.

In a number of small plants in Kentucky, clear water wells have been omitted, a pump being connected directly to the filter discharge pipe. The pump must be regulated to prevent drawing faster than the safe filtering rate. A tank must be provided for the wash water, since with no storage of filtered water at the plant, a pump cannot be used.

The Palmer filter sweep consists of revolving nozzles which, operating under a head of 80 to 100 pounds, break up the surface of the sand by jets of water. The sweep is run for 3 or 4 minutes before washing begins, then the washwater is applied at a rate sufficient to make the sand fluid. Wash water is reduced 25% to 40%.

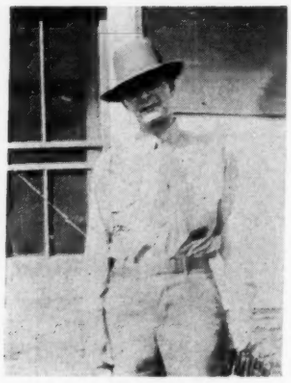
Coagulation Processes and Chemicals

Aluminum sulphate, ferric and ferrous sulphate and sodium aluminate are among the chemicals used for coagulation. Which is the best and most economical to use depends upon many local conditions, including, perhaps one or all of the following: alkalinity or acidity; mineral content, or the lack of it; taste and odor conditions; turbidity; and color. In general, the coagulant used must be adapted to the water, rather than to attempt to adapt the water to the chemical. Proper equipment for mixing the chemical and for flocculation improves results and reduces costs of chemicals.

Temperature effects on coagulation has been the subject of considerable discussion. Studies by Velz[5] on samples of water artificially chilled indicated that when the temperature rises from 48°F to 70°F , a considerably larger dose of alum is required; also, that at summer temperatures, a lower pH is required for best coagulation. These observations do not agree with recent experiences in the use of alum for sewage coagulation, where temperature ranges from 34°F to 65°F did not require any noticeable variation in the alum dose; nor with the findings reported by Streeter some years ago and verified by a recent letter. The Richmond, Va., water plant reported a couple of years ago that more alum was required for coagulation when water temperatures fell below about 40°F.

The use of silicates to aid coagulation continues to be of much interest. The silica solution used for this purpose is acidified to neutralize most of the alkali in the silicate solution. The amount of silicate required to give maximum aid to coagulation is 25% to 40% of the amount of alum used. Silicate can also be used to aid coagulation with ferrous sulphate but is generally less effective with ferric salts. The principal effect is believed to be in aiding the formation of large and tough particles of flock which are not so easily broken and which settle quickly.

Please turn to page 30 for conclusion and bibliography. Descriptions of some new devices are shown on pages 32, 33 and 34.



H. H. Babcock

Building an Adequate Airport With Limited Funds

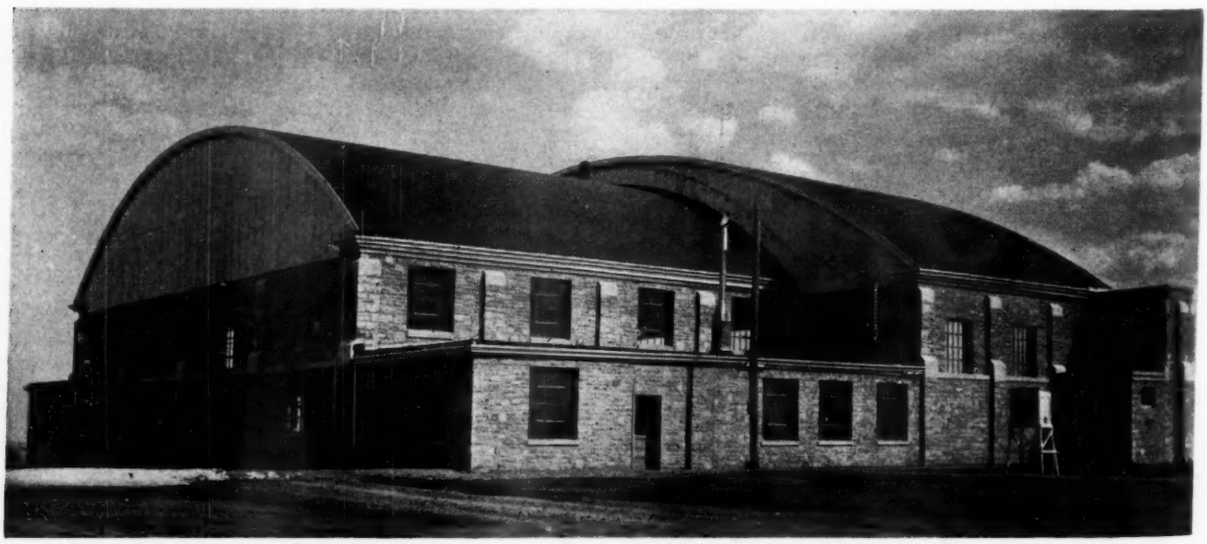
By H. H. BABCOCK
City Engineer of Rapid City, South Dakota

RAPID CITY, South Dakota, believing it desirable to have a place in the fast-moving aviation world, and finding that its old airport site would be inadequate to meet Government requirements and future demands, decided in 1937 to obtain a new site and construct thereon a combination hangar and administration building, grade runways for temporary use, and provide other necessary facilities; with the idea of more extensive improvements later when increase in air transportation should demand them.

Before making definite plans, A. S. Holm, City Manager, and the writer inspected various airports in several cities in the middle west and consulted the officials of them in order to profit by their experiences. Although we did not expect to be able to fully complete and equip our airport at this time, we thought it advisable that what we were able to do now should be along the right tracks to continue to serve as a useful part of future developments.

It was thought probable that it would be possible, with the help of WPA, to purchase a site and complete the work immediately contemplated for $30,000 and a bond issue for this sum was voted. A WPA project was approved in February 1938 for $38,810.25 of which $17,520.06 was to be the sponsor's share. Later it was found that this would be insufficient and a supplementary project was approved in September for $26,177, of which $11,778 was to be the sponsor's share. The land for the field cost $12,520; and other expenses (detailed further on in this description) brought the city's share of the cost to a total to date of $34,224.49. The project as outlined for present construction has been finished except the main doors of the hangar.

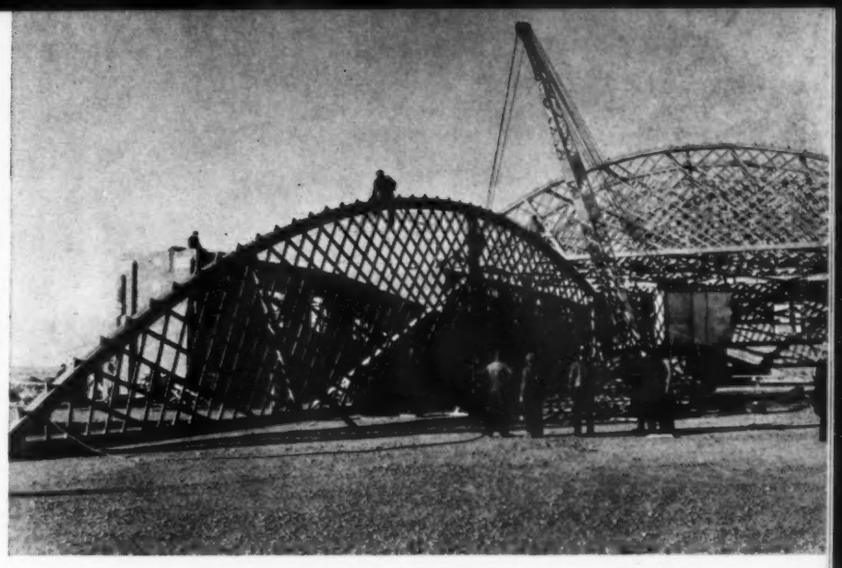
The topography of the surrounding country made it difficult to find an adequate site near the city; but one was finally selected that met with the unanimous approval of both government officials and men of the flying profession. This field is located 9 miles from the post office, 1½ miles from a paved trunk highway. It contains 640 acres in the form of a square, all easily made available for landing except about 30 acres in the southeast corner which contains a ravine. The general natural topography of the field is fairly flat with a very small amount of grading necessary to construct four runways with a maximum longitudinal grade of 0.8%. The field has excellent natural drainage to the southeast, with all points visable from almost any other point on the field, particularly at the site of the hangar and administration buildings which are located on a slight rise on the west side of the field. The following four runways were laid out: North and South—4900 feet long; East and West—4900 feet long; Northwest and Southeast—5500 feet long; Northeast and Southwest — 5200 feet long. All runways were graded 200 feet wide, with adjacent areas leveled up for available landing and all usable area enclosed with standard markers. As no runways involved any prohibitive grades, extensive grading was necessary only in a few places to obtain a more uniform grade line; the object being to leave the natural sod undisturbed



Rear view of building, showing weather bureau annex. The administration part of the building is on the opposite side.

when practical until such time as an extensive paving program can be undertaken.

A total of approximately 30,000 cubic yards of excavation was moved. The bulk of this was accomplished with a city-owned RD8 Diesel Caterpillar tractor and an 8-yard LaTourneau scraper rented from a contractor. Other filling up of holes and general leveling was done by trucks loaded from a trap in a borrow pit. An elevating grader and six dump trucks were also used for four days. It was found that the LaTourneau scraper was ideal for this type of work, as shallow cuts could be peeled off without ripping, hauled comparatively long distances, and spread in thin layers for light fill, leaving very little blading or finishing to do.



Raising 120 ft. span truss with 45 ft. boom attached to gas shovel. (The 80 ft. trusses are all in place.)

The Hangar

In choosing a design for a hanger it was decided to construct one that would involve a minimum of expense and yet be adequate to serve the present and contemplated needs for the next few years. A "T" shaped hangar was agreed upon, with an annexed temporary administration building on one side at the rear and an annexed shop on the opposite side; the ground plan of the whole being a rectangle 120 x 100 ft. The front portion is 120′ by 40′, with 120′ by 22′ clear door opening, and the back portion is 80′ by 60′. Each annex is 20′ by 60′. The height of the hangar walls is 22′. All the walls are built of native limestone, quarried by WPA hand labor, hauled 12 miles to the hangar site and laid on a concrete foundation wall. The thickness of the walls is 24″ on the 120′ span portion and 18″ on the 80′ span portion, with the annex walls 12″. A 5″ concrete floor was constructed throughout, including both annexes.

Wooden latticed bow trusses were designed for the roof, mainly to take advantage of the WPA labor. These were constructed on the ground. A considerable problem arose as to how these could be most easily raised into place. It was finally decided to rent a gas shovel with a drag line boom 45′ long to raise the trusses and swing them into place. This worked surprisingly well although it was necessary to side truss the 120′ trusses with cable to keep them from buckling and also to crib up the shovel to obtain more height. For the 80′ trusses, one hitch in the center was all that was necessary, but for the 120′ trusses an additional hitch half the distance on each side was necessary. The whole operation required only three days, including temporary bracing, cribbing, etc. The four 80′ trusses were raised in place the first day. The roof is constructed with diagonal sheathing on the purlins and covered with 10-year built-up roofing. Galvanized corrugated metal nailed on crossed diagonal sheathing comprise the gable ends.

A power line 7.5 miles long was constructed from the city limits to the airport, the city buying the materials and the WPA furnishing the common labor. A local electric shop contracted to oversee the construction and furnish the skilled labor. This line will be adequate to handle all future demands for power and airport lighting for some time to come.

The U. S. Weather Bureau has installed a complete modern up-to-date Weather Bureau station with 24-hour service and a personnel of five regular employees. They are utilizing all of the 1,200 square feet of floor space in the west annex. In connection with their office, a balloon house and other instrument facilities were constructed as part of the project.

The administration building consists of waiting room, two offices, ladies' and men's toilets and a lunchroom. Original plans called for maintenance shops in the west annex, but this was finally finished off to provide temporary offices for the U. S. Weather Bureau until such time as a separate building can be built for them.

Chenoweth, Frazer and Forrette of Rapid City were the architects for the building.

TOTAL CITY'S CONTRIBUTION TO COSTS OF AIRPORT

Temporary buildings		$624.88
Field:—		
Fencing	$ 197.00	
Markers	30.04	
New equipment	7,000.00	
Equipment rental	932.00	
Gas, oil, etc.	241.83	
Labor (by city)	1,906.23	
Miscellaneous	59.00	$10,366.10
Hangar:—		
Building rock	$ 250.18	
Sand, crushed rock and gravel	845.60	
Materials, lumber, etc.	2,204.41	
Plumbing	173.66	
Electrical	175.00	
Equipment	210.79	
Equipment rental	365.00	
Gas and oil	215.06	
Labor (by city only)	675.00	
Truck and driver	921.75	$6,036.45
Land		$12,520.00
Power line from city		3,120.05
Expense of bonds		883.70
Architect for hangar		500.00
Miscellaneous		173.31
City's total cost to date		$34,224.49

WPA furnished the labor, cement and lumber for the trusses, all of which are not included in the above cost.

At the present time the Inland Air Lines, Inc., are the only commercial air lines operating in and out of Rapid City. They operate one 10-passenger plane each way (East and West) daily, carrying both mail and passengers en route between Cheyenne, Wyoming and Huron, South Dakota, making connections with transcontinental lines.

Rapid City now has an airport with potential possibilities second to none in the middle west; and congratulations should be extended to the City Commission, City Manager, WPA officials and all others who have contributed their efforts in bringing this project to a realization.

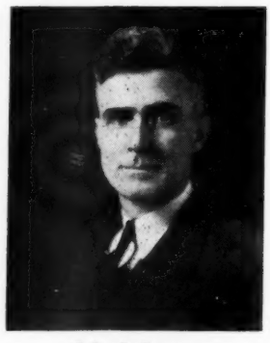
San Francisco Eliminates Beach Pollution by Sewage Treatment

BY JOHN J. CASEY
City Engineer

A broad program involving the construction of sewage treatment plants, pumping stations and sewers has been prepared to obviate pollution of beaches in and near the city. This article outlines the program and describes the recently completed Richmond-Sunset plant.

As a major unit in a comprehensive program of improvement in sewage disposal, the City of San Francisco has completed the Richmond-Sunset sewage treatment plant, under the direction of A. D. Wilder, Director of Public Works. This plant and the other units follow the general program set up by a board of consulting engineers, in a report submitted in May, 1935. This board, consisting of the late Harrison P. Eddy of Boston, Professor Charles Gilman Hyde of Berkeley, C. C. Kennedy of San Francisco, and Professor Leon B. Reynolds of Palo Alto, was appointed to make a study of conditions, advise on a long-range program for the city as a whole, and expenditures under the 1933 P.W.A. sewer bond issue.

Previous to the present construction work undertaken under that bond issue, there had been no provision for sewage treatment in San Francisco, although the subject had been under consideration by the Bureau of Engineering for a number of years. The untreated sanitary flow has been discharged, except in one instance, through a number of separate outlets at various points along the bay and ocean at the shore-line. Due to the action of the tides, the whole shore-line was polluted, as evidenced by the appearance of sewage fields offshore, deposits at the shore, and bacterial tests for B. Coli, which showed that approximately 80 per cent of the samples taken along the north shore, and from 20 per cent to 80 per cent along the west shore were above the allowable limit for beach pollution.



John J. Casey

Since the north and the west shores are those most widely used for recreational purposes, and because of the contemplated extension of recreational facilities along the north shore, it was proposed that the first construction go toward cleaning up the pollution in that section.

General Program:

The board recommended that the following works be constructed with funds from the 1933 P.W.A. sewer bond issue:

1. Marina pumping plant and the discharge line to North Point. This pumping plant takes the sewage from the Marina District and discharges it at North Point, the present point of discharge of the major part of the flow to the north-easterly portion of the city. By this means the direct source of pollution at the Yacht Harbor is removed and the conditions at Aquatic Park are improved. In the future a treatment plant will be built at North Point for the combined sanitary flow from the North Point and Marina Districts, and the effluent will be discharged approximately 2500 feet offshore into deep water.

2. Richmond sewer tunnel and connecting sewers to the Richmond-Sunset sewage treatment plant.

3. Richmond-Sunset sewage treatment plant. The westerly portion of the city is divided topographically into two major districts, the Richmond and the Sunset, the latter including West Richmond.

The flow from the Richmond District was discharged at Baker's Beach, which resulted in polluting Baker's, China, and other neighboring beaches, while the flow from the Sunset and West Richmond Districts discharged at Mile Rock outlet, polluting Land's End Beach and the ocean shore.

Since it was not possible to obtain a site for a treatment plant near Baker's Beach, the best solution was the combining of the flows from the two districts for treatment, and the disposal of the treated effluent through the Mile Rock outfall.

The combining of the flows necessitated: (1) Construction of the Sea Cliff pumping plant and discharge line for the area too low to flow by gravity into the Richmond sewer tunnel; (2) the Richmond sewer tunnel, carrying the flow from the Richmond District southwesterly to Fulton street; (3) a trunk sewer westerly on Fulton street; (4) a connecting sewer carrying the combined flow of the West Richmond District and the Richmond District to the plant; and (5) the Richmond-Sunset sewage treatment plant, the flows from the Sunset District being pumped to the plant inlet by a pumping station located at the treatment plant.

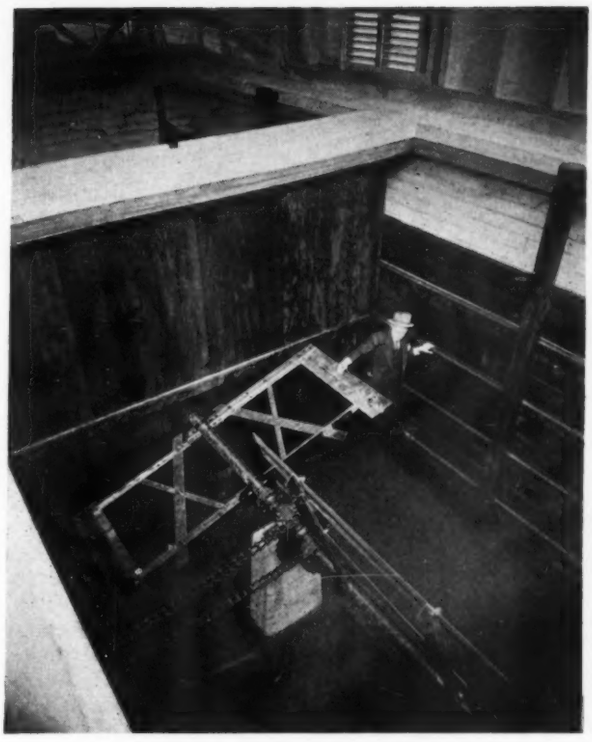
The Marina pumping plant and the discharge line have been completed and are in operation; the Richmond sewer tunnel and the Richmond connecting sewer are completed. The Richmond-Sunset treatment plant went into operation in February, 1939.

The design and construction have been under the direction of the Bureau of Engineering of the Department of Public Works.

The areas, populations, and flows from the tributary districts to the treatment plant are as follows:

Sanitary Flow Data for Areas Tributary to the Richmond-Sunset Plant:

District	Area in Acres	Population 1930	Population Initial Design	Population Ultimate Design	Aver. Daily Flow Gal. per Cap.
Richmond	1425	66,500	80,000	100,000	100
West Richmond	495	10,000	15,000	20,000	60
Sunset	4905	70,000	105,000	190,000	60



Mixing tank, showing baddles

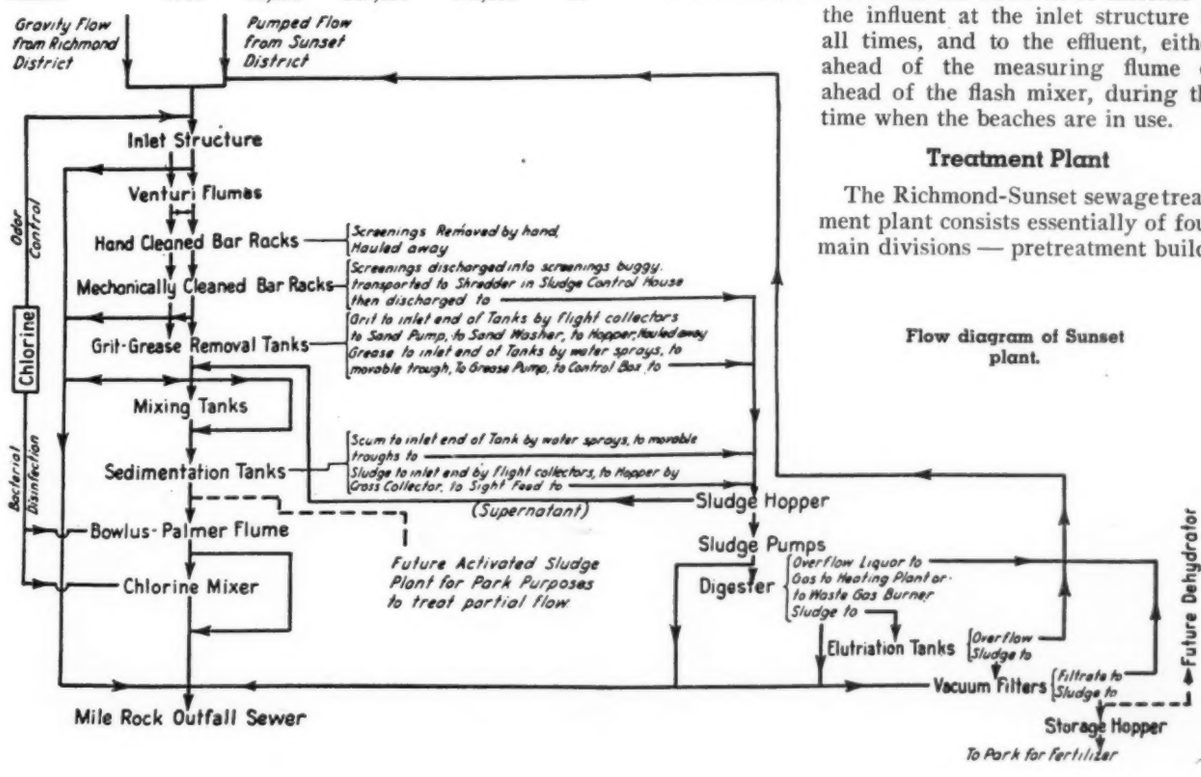
The flow from the Sunset District, which discharged without treatment through the Mile Rock outfall sewer, is now diverted to pumps located in the main building of the plant by a removable dam placed in the sewer. During times of flood this dam can be raised by air hoist and the plant be by-passed.

The gravity flow from the Richmond District and the pumped flow from the Sunset District are combined at the inlet structure, from where they are carried to the pretreatment building.

Provision has been made for addition of chlorine to the influent at the inlet structure at all times, and to the effluent, either ahead of the measuring flume or ahead of the flash mixer, during the time when the beaches are in use.

Treatment Plant

The Richmond-Sunset sewage treatment plant consists essentially of four main divisions — pretreatment build-



Flow diagram of Sunset plant.

ing, mixing-sedimentation building and sludge control house, digester, and main building.

Pretreatment Building

This is a three-story building approximately 120′ long by 55′ wide, housing equipment and structures to measure the incoming flows, feed chlorine as previously described, and remove large floating debris, grease, and grit.

The incoming flows are measured by Stevens water level recorders, 3 functions, operated by floats set in stilling wells off of 3-ft. Parshall venturi flumes.

Hand cleaned bar racks, 4″ openings, and Link Belt mechanically cleaned bar racks, ¾″ openings, are set in the inlet channels. The screenings from the hand cleaned bar racks are removed by hand, placed in containers and hauled away. The screenings from the mechanically cleaned bar racks are discharged into screenings buggies, hauled to the sludge control house, ground by a Rex triturator and discharged to the sludge thickening tanks.

Grit and grease are removed in four Imhoff-type tanks approximately 50′ long by 12′ wide by 10′ deep, with provisions for transverse circulation set up by air from diffuser plates for collection of grit at one end by Link-Belt pivoted flight collectors, and collection of grease from the grease collecting zone by water sprays. Each tank has a capacity of 3.75 mgd based on 10 minutes holding time. (Only two tanks are equipped at present. The others are to be equipped as soon as funds are available.)

The air to the diffusers is pumped by three Sutorbilt positive rotary displacement blowers, two with a capacity of 225 cu. ft. of air per minute, and one with a capacity of 275 cu. ft. of air per minute. A 1600 cfm American air filter and a Burgess silencer have been installed on the air inlet line ahead of the blowers.

The grit collected at the inlet end of the grit-grease tanks is pumped to a Dorr grit washer, "Detritor" mechanism, the washed grit being collected in a hopper and hauled away by truck and the organic material returned to the incoming line to the grit-grease tanks.

The grease collected at one end of the grit-grease tanks by water sprays is removed by flowing over a movable trough into a storage hopper and then pumped to the sludge thickening tanks in the sludge control house.

Provision has been made for the storage of twelve 1-ton chlorine cylinders, which are delivered by truck, removed by an electric crane hoist and set on special spring supports which indicate when the cylinders are empty. Six cylinders are connected to one header, no evaporators being used. On each header is a pressure reducing valve and an alarm assembly.

Special provision has been made in the chlorine storage room for ventilation by openings at the floor level, and for prevention of leaks to the rest of the building by the use of special doors with rubber gaskets.

There are two 1500 lbs.-per-day Wallace & Tiernan master vacuum solution feed chlorinators for feeding chlorine to the incoming sewage 100 ft. ahead of the plant for odor control, and to the effluent before discharge to the outfall sewer for bacterial disinfection, both feeds being in proportion to the flow. Piping is so arranged that either or both of the chlorinators can be used to feed to either or both points of application.

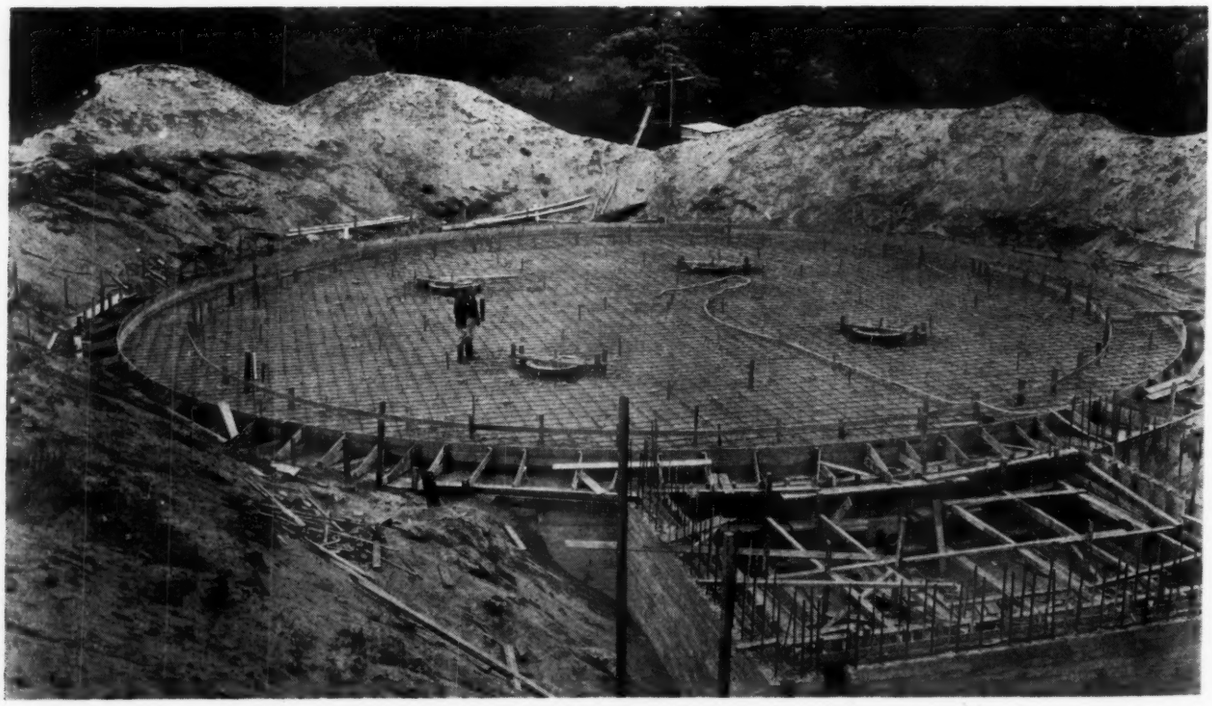
Mixing-Sedimentation & Sludge Control House

This is a two-story building approximately 175′ long by 70′ wide housing equipment and structures to remove material that will settle and to thicken the combined screenings, grease and sludge, and to pump the thickened sludge to the digester. The final treated sewage is discharged into the Mile Rock sewer.

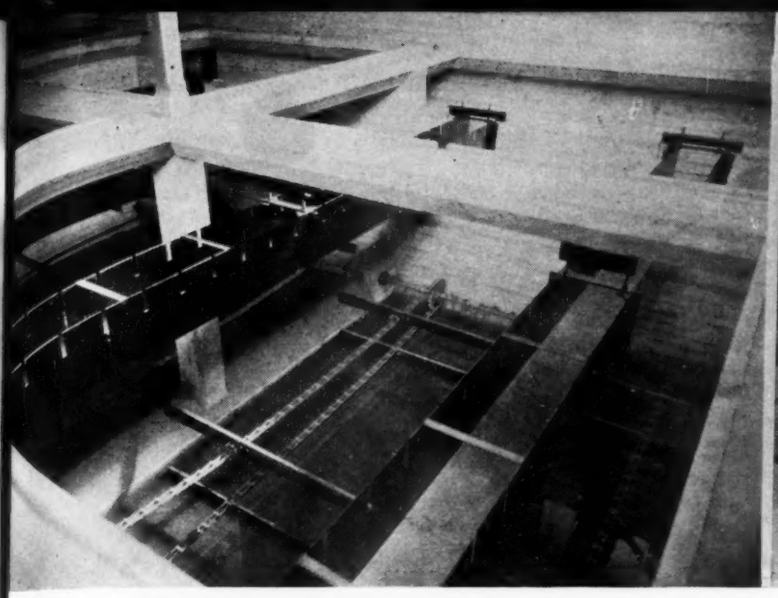
The sewage after leaving the pretreatment building goes to the influent channel in the mixing-sedimentation building. A valve arrangement allows for the sewage to be treated in any of the following steps:

a. Mixing tanks to sedimentation tanks in parallel.
b. Two mixing tanks to one sedimentation tank.
c. One mixing tank to two sedimentation tanks.
d. Mixing and sedimentation tanks in series.

The mixing tanks are 33′ 6″ square with a 10′ water



Bottom slab of digester, showing reinforcement and bottoms of the four turbo-mixers



Sedimentation tanks, showing chain-driven sludge collectors and effluent flumes.

Hand-cleaned bar rack at lower left; casing of mechanically cleaned racks above the floor.

depth, baffled into four bays, the sewage flowing through each of the four bays in series. Agitation is provided by Dorr horizontal flocculators driven by Sterling Varidrives to obtain a speed at the periphery of the paddles of from .5 to 2 feet per second.

The sedimentation tanks are 33′ 6″ wide by 100′ long, with a 10′ water depth, with provision for collection of sludge by Link-Belt "Straight line" collectors, removal of effluent over four notched troughs 25′ long, and removal of scum by water sprays to the inlet end of the tank, whence the scum flows over movable troughs to the sludge thickening tanks.

Four mixing and sedimentation tanks are required for the design capacity, but only two have been built because of the lack of funds.

Experiments conduced by the City of San Francisco showed that a considerable increase in the efficiency of the removal of suspended solids could be obtained by plain mixing ahead of sedimentation without the use of any chemicals. Accordingly the plant was designed for mixing tanks with one-half hour detention period and sedimentation tanks with one and one-half hour detention period. Laboratory tests made to date show that the results obtained are greatly in excess of those possible with plain sedimentation.

Grease from the grit-grease tanks, the shredded screenings and the sludge from the sedimentation tanks are collected in sludge thickening tanks, concentrated, the supernatant returned to the influent channel to the sedimentation tanks, and the thickened sludge pumped to the digester by "Chicago" sewage pumps. Each of the two thickened tanks has a capacity of 17,500 gallons, which is equivalent to the sludge from three million gallons of sewage at 95% moisture.

A Bowlus-Palmer measuring flume is located on the effluent line from the sedimentation tanks to the sewer, the flows being measured by Stevens water level recorders, 3 functions, operated by a float set in the stilling well off of the flume. A chlorine converter is located in the same stilling well so that chlorine is added to the effluent in proportion to the flow after being mixed in a Dorrco flash mixer.

The Digester

This is a concrete tank with steel dome, 80′ inside diameter by 30′ sides. It receives the thickened sludge from the sludge control house and retains it for approximately 25 days at about 95° F.

The digester is the first unit of a Dorr multi-stage digestion system, being equipped with four turbo mixers and four vertical heating coils located next to the turbo mixers. As the secondary digestion tank is not installed at present, the unit is operated as a single-stage digester, the two lower impellers being removed and the top impeller used as a scum breaker. The digester is equipped with an inlet control box and a discharge control box, both vented to the atmosphere. Provision has been made so that the sludge can be withdrawn either from the discharge control box or from the bottom of the digester to the elutriation tanks or to the sewer by gravity, or by use of a "Chicago" centrifugal sludge pump in case the line should become plugged.

The supernatant is discharged back to the sewer ahead of the Sunset pumping plant in the main building. The gas, after flowing through condensation traps, is utilized in the boilers for heating the building and recirculated hot water for the digester, or is by-passed to a waste gas burner.

The Main Building

This is a three-story building approximately 130′ long by 50′ and 67′ wide, housing equipment and structures to wash and dry the sludge from the digester and convey it to hopper for loading on trucks, and to pump the Sunset sewage to the plant inlet; also boiler room, office, laboratory, shower and locker room, storeroom, machine shop, switchboard, etc.

Sewage Pumping. The sewage from the Sunset District is carried to the plant in the Mile Rock sewer, which is the same sewer into which the effluent from the plant is discharged. A diversion structure with an 11′ wide concrete gate, which is raised by a Hanna air hoist during times of storms, is used to divert the sewage to the Sunset pumping station located in the main building.

A float-controlled, hydraulically operated basin level regulator to prevent the level in the sump from rising above a set elevation, and a float-controlled, hydraulically operated shut-off valve to shut off the flow to the sump in case the basin level regulator does not operate properly, are installed on the inlet line from the diversion structure to the Sunset sump. Provision has been made for collecting sand deposited in the sump by a Link Belt sand scraping mechanism to a pit in one corner of the sump and the pumping of the sand to a Dorr sand washer discharging to one of the elevated hoppers, to be hauled away by truck.

The sewage is pumped by three "Chicago" sewage pumps, one with a capacity of 800 gallons per minute

against a total dynamic head of 32 feet for low flows, and two with a capacity of 1800 gallons per minute discharging against a total dynamic head of 35 feet, and 4000 gallons per minute discharging against a total dynamic head of 43 feet each, the low speed not to exceed 695 rpm and the high speed not to exceed 870 rpm.

Provision has been made for controlling the pumps by an Automatic Flow Company controller, and for measuring the flow by a Bailey three-function recorder.

Sludge Dewatering. The sludge from the digester is first treated by the Genter elutriation process, filtered by an Oliver vacuum filter, conveyed by belt conveyors and discharged to hoppers, from which it is emptied into trucks and hauled to city parks to be used as fertilizer.

The layout for the elutriation process consists of a 4″ Bailey meter for measuring the sludge, a Sparling meter set in an 8″ line for measuring the wash water (plant effluent), two vertical mixing tanks 4′ diameter by 7′ 6″ high and two settling tanks with Link-Belt Straightline collectors, each approximately 14′ 6″ wide by 50′ long with a 8′ 6″ water depth, with provision for using one or two tanks and for re-circulating the sludge by pumping with a Rex plunger sludge pump.

From the elutriation tanks the sludge flows by gravity to a storage hopper holding approximately 40 tons of sludge, from which it is lifted by a Rex bucket elevator and discharged into the sludge conditioning mixer (maximum five-minute holding time).

The ferric chloride used for conditioning the sludge is delivered by trucks in solution form, discharged by gravity to a concrete storage tank 13′ long by 3′ 6″ wide by 5′ high with a special lining, and pumped by a Duriron pump through rubber-lined pipe to two ferric chloride solution tanks 3′ diameter by 5′ high with special lining.

The ferric chloride is fed into the sludge conditioning mixer by an Omega solution feeder driven off of the bucket elevator drive so that the ferric chloride is fed in proportion to the feed of sludge. The conditioned sludge flows by gravity to the vacuum filter, the quantity being automatically controlled by the level in the filter tank. The sludge is filtered by an 8′ diameter by 8′ long (200 square feet filter area) Oliver filter using wool cloth. The accessory vacuum filter equipment consists of an Ingersoll-Rand vacuum pump, Duriron filtrate pump, and a Sutorbilt positive rotary displacement blower.

The sludge from the vacuum filter is carried by a 24″ flat horizontal belt conveyor to a hopper, then to a 24″ inclined troughing belt conveyor set at an angle of approximately 28 degrees, and then discharged onto a 24″ troughing reversible shuttle belt conveyor feeding any one of seven sludge storage bins, each bin 6′ wide by 5′ long by 6′ deep. Each bin has a storage bin gate operated manually by Wright high-speed spur-geared hoists.

An operating panel is located on the filter platform so that the operator can start or stop any pump for the vacuum filter circuit or can move the conveyor. Colored lights indicate what motors are operating and what motor or motors have kicked out due to any cause.

There are two Kewanee steam boilers, capacity of each 4860 feet of steam radiation, with provision for burning either natural gas or digester sewage gas, and equipped with balance dampers. Automatic controls have been provided for the boilers so that when operating on digester gas, if the quantity of gas production is greater than the demand, the excess is automatically by-passed to the Pacific Flush Tank waste gas burner, or if the demand exceeds the production, the digester gas is shut off and the natural gas goes on. Provision is also made for manual control in case of any trouble with the automatic controls. The temperature of the re-circulated hot water to the digester is controlled by a Mason Neilan temperature controller. The steam from the boilers is also used for heating the building.

The plant at present has a dry weather flow of approximately 8 mgd, with a peak flow of approximately 14 mgd and a minimum flow of approximately 2 mgd. The sewage is straight domestic with an average strength of approximately 375 ppm suspended solids and 400 ppm B.O.D.

Since the plant has been in operation there is a noticeable improvement in the beaches and shore waters.

With the completion of this work, a major step has been taken toward protection of the beaches by treating all sewage before discharge into bay or ocean.

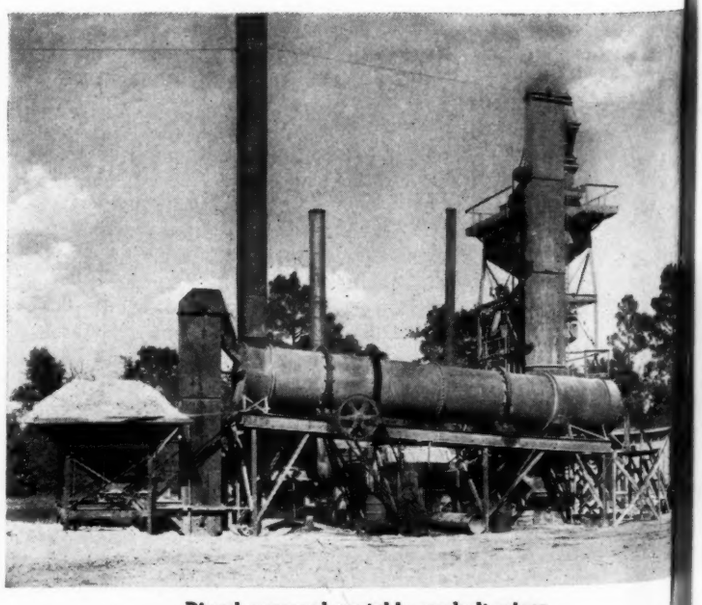
Diesel-Operated Portable Asphalt Mixers

Sixteen large-capacity portable asphalt plants to provide hot mix for road construction and maintenance are being used by Sam Finley, highway contractor of Atlanta, Ga. The plants are operated by Diesel engines. The plant shown has a capacity of 100 tons per hour. It was utilized last season to provide mix for surfacing on State Route No. 1 between Bainbridge and Colquitt in southwestern Georgia. It was operated by two International Diesel power units, the maximum horsepower of these being respectively 100 and 62.5.

The larger power unit operated the hot-sand elevator, vibrating screen, rotary drum, air compressor and deep-well pump, while the smaller one operated the rotating sand-drying drum and horizontal sand conveyor under hopper and elevator for raising sand to drum.

Two types of mix were made. One mix was for 3-inch base and consisted of 7 per cent asphalt and 93 per cent sand, which was taken from a nearby pit. The other mix consisted of 9½ to 10 per cent asphalt, 10 per cent mineral filler, and 80 per cent sand and was for 2-inch sheet top.

Sand was delivered to the 30-ton hopper at the left by a clam-shell. From the hopper, sand was conveyed to the sand elevator and thence to the drying drum, which is 42 feet long and has an inside diameter of 90 inches. Heat was provided by two oil burners.



Diesel powered portable asphalt mixer

The Editor's Page

Making Plans to Lick Old Man Winter

Most of our readers, no doubt, appreciate that fighting old man winter is a tough proposition, requiring an almost military organization. Necessary steps are the procurement of personnel and their training; organization to employ these men to the greatest advantage; modern equipment to enable them, most effectively and economically, to combat snow and ice. In general, roads are kept open and safe to a most praiseworthy degree; but a real storm always catches a few unprepared.

It is a handicap to those in charge of snow removal and ice control that winter plans (purchases, too) so often have to be made in the summer. With the temperature pushing the mercury out of the upper end of the thermometer, it is hard to be properly generous in providing necessary equipment, even though we all know that a good snow plow on the business end of a reliable truck is worth any place from ten to a thousand plows ordered by telegraph but not yet delivered. And an icy hill covered with properly prepared cinder or sand brings to the motorist a pleasant glow which is wholly absent if the sand is still in the bin.

Now is the time to get ready for winter, to plan for the work, arrange for men and trucks, and lay in an adequate supply of the tools that will, sooner or later, be needed for snow and ice control. The most costly plow that any highway or street department can have is the one that is needed but not at hand.

Sewerage and Water Plant Operators Also

Cold weather brings problems to the water works superintendent and operator; and to the sewage plant operator too. In our June issue, we discussed some of the factors in connection with the operation and maintenance of a water distribution system, and mentioned the methods for winter care of hydrants and elevated tanks—the parts of a distribution system which perhaps are most susceptible to cold weather. Now is the time to get ready to check on these and other items that experience has shown give trouble in cold weather. Also to make sure that equipment for thawing services is on hand and in serviceable condition; that all valves are in good condition and easily findable under a deep cover of snow and ice.

The sewage treatment plant operator should see that his trickling filter (if he has one) does not pond, for that is the first step toward having cold weather trouble. Before cold weather comes, it is well to remove as much sludge from the digester as possible, because drying on open beds, at least, is all but impossible during the winter. In one plant, plans are being made to heat the covered sludge beds with hot air from the gas burner. The heating apparatus for the digester may be checked up to be sure that the proper temperature can be maintained during the colder periods.

Intakes of water systems, reservoirs and even pumping stations are points of potential danger and trouble in cold weather. The chlorinator needs protection, whether for water or sewage treatment. An item-by-item check of possible sources of trouble, and the correction of defects that may cause trouble under the stress of zero weather is a good job for the fall months. Properly done it will make for a much more pleasant winter.

The English Have Their Highway Worries, Too

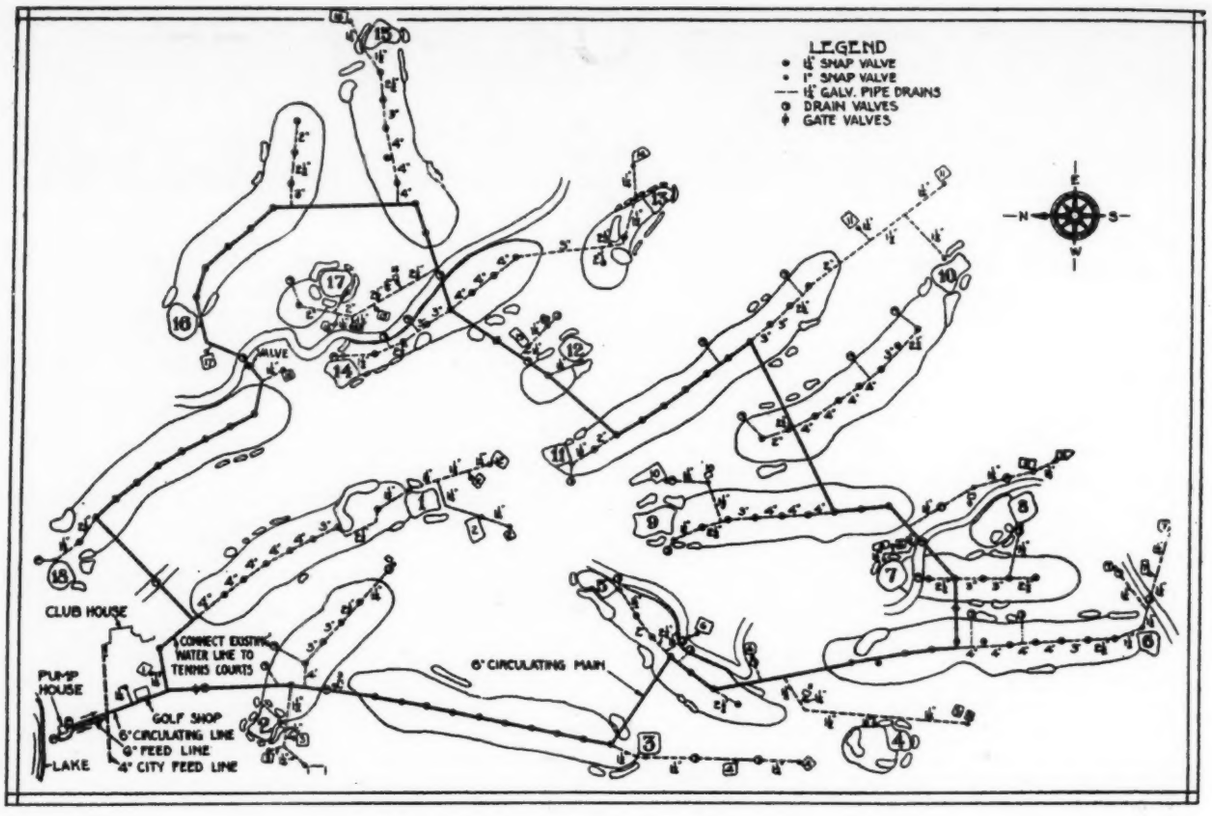
There are somewhat less that three million motor vehicles in Great Britain, including motorcycles of which there are about half a million. The total of motor taxation for the year ending March 31, 1939, amounted to slightly more than $400,000,000, of which about 60% came from gasoline taxes and 40% from vehicle taxes. For the purpose of comparison, there are around twenty-nine million motor vehicles in the United States, and the taxes on them, on one basis or another, is around $1,450,000,000. Thus, in the United States, the tax per vehicle is around $50 each, while in Great Britain it is close to $140 per vehicle.

This doesn't mean that higher taxes can be assessed against motor vehicles in this country, nor that more of our funds can be diverted from the purposes for which they are collected. Because of the very much greater mileage of roads in the United States, more money is needed for construction and maintenance; on the other hand, highway transportation is an essential of present day commerce and business. It cannot be restricted without producing adverse effects on our economic structure; and to place an undue burden on it would be to unsettle or even dislocate the closely woven tissue of commerce. Present day income from motor vehicle and gasoline taxes is fairly sufficient to meet the needs of our highway system, if diversion is ended. Highways are not a financial burden to the nation; they pay their own way; and in addition contribute to national economy and comfort to an extent that is difficult to realize.

The Next Step in Sewerage: Better Sewer Construction

Many of our sewer systems date back forty years or more; some were built carelessly; others of poor material; and the design was not of the best in a good proportion of them. This combination makes for difficulty in sewage treatment.

We do not advocate a wholesale replacement of existing sewer systems, but we do urge most strongly that on all new work, materials and methods of a suitable nature be employed. In wet ground, special pipe and the best kind of joints are needed. In any construction, cheap pipe and slipshod construction have no place. In addition to extensions, there are in nearly every city and village, sections that for one reason or another need reconstruction. Since these are generally in critical places, rebuilding of them also should follow high standards.



Layout of a water supply system for a typical golf course.

Designing a Water Supply System for a Golf Course

THE average golf course consists of eighteen greens, thirty-six tees and fourteen fairways. The greens and tees should always be watered. The amount of water required for this purpose will usually be 150 to 175 gallons per minute. The pressure against which this water must be supplied depends upon the topography of the course and the source of supply, also. In the majority of cases, a head of 100 to 150 feet at the pump will take care of most of the tees and greens.

The fourteen fairways (there are frequently no fairways on the four short holes) average 300 yards long and about 60 yards wide, amounting to about 52 acres. The advantages of watering fairways is very great. In the east, the summer of 1939 was an exceedingly dry one, and all vegetation suffered a great deal. No doubt, there will be a considerable trend toward fairway watering in the future.

The Department of Agriculture estimated that a good healthy turf requires one inch of water per week, but that this should be applied at a rate of less than one-quarter of an inch per hour. A faster rate results in flooding. One inch of water per week on an acre amounts to 27,150 gallons of water.

With an application of 27,150 gallons per acre per week, the 52 acres representing the fairways on the average golf course will require 1,415,000 gallons per week. If the application of this water is made through seven night hours, seven days a week, or about 3000 minutes, the pumping rate will be 472 gallons per minute.

Therefore a pump of about 500 gpm capacity will be required. A flat course will require 100 to 115 pounds pressure (230 to 266 feet) at the pump; a hilly course may require as much as 180 pounds (414 feet) at the pump. The cost of a complete system, which usually involves purchasing a considerable amount of pipe and fittings, as a rule amounts to $20,000 to $30,000. The watering system at the Mayfield Country Club, Cleveland, (described in *Plumbing & Heating)* required about 25,000 feet of pipe, 1¼ to 6 inches in diameter.

Best results are attained with water that is not too cold. Therefore if the water supply is from deep wells, it should be stored in an artificial lake or reservoir or pond until it reaches atmospheric temperature. It can be drawn from the lake or reservoir for application to the course. Elevated storage often reduces insurance and may be desirable from that viewpoint. Costs of operation of several clubs in the Chicago area for watering fairways amount to $2,000 to $4,000 per year for all items, including labor.

This information was furnished through the courtesy of Economy Pumps, Inc., Hamilton, O.

Modernizing Old Macadam Pavements

By R. H. ALBRECHT
Engineer, Board of Water, Light & Sewer Commissioners

LIKE many other villages, Hamilton, New York, has progressively developed its streets from graded dirt, through gravel and bituminous treatment, to paving suitable for modern traffic. The gravel roads were scraped and oiled every year and gave fairly good service. Those carrying the heaviest traffic were later surfaced with crushed stone penetrated with asphalt or tar and are still in good condition.

However, this successive resurfacing has raised some of the roadways until the crown is higher than the sidewalks, causing rather difficult drainage problems. Also increased weight and amount of traffic on Utica and Broad Streets, which are in the State highway system, made necessary some type of heavy construction on these streets. In 1936 the State Highway Department, acting in close harmony with village officials, constructed a pavement consisting of a 6-in. concrete base with a 2-in. Colprovia wearing surface for the entire distance of the State highway through the village. Curbing was set and storm sewers constructed as a part of the project, the former being the only part assessed directly against the abutting property.

With this modern pavement as an inspiration, the village in 1937 inaugurated a program of "Modernizing Old Macadam Pavement." Keeping up the old macadam pavements had been costing $6,000 to as high as $10,000 a year, and it was thought that by putting a portion of the highway budget each year into a piece of modern road construction the village would gradually acquire a modern street system.

R. H. Albrecht

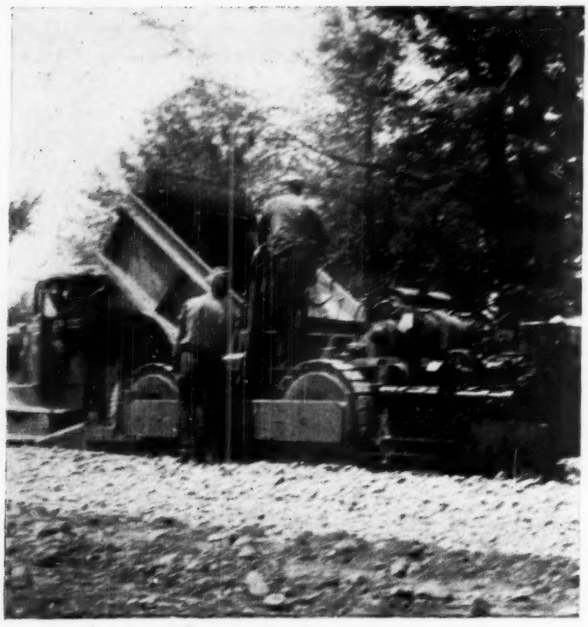
As a first step, a new road was constructed on the east side of the park in Broad Street, to make it as attractive as the west side which was the already-improved State highway; this to include a storm sewer system and curbing on both sides. The storm sewers, catch basins and manholes were constructed first. Then the curbing was constructed, 18 in. high, 6 in. wide on top beveled to 8 in. at a depth of 10 in., drained with porous tile laid in a 6 in. bed of crushed stone. Steel forms were used for the curb, which was constructed of sand, No. 1 crushed limestone and portland cement mixed 1:2:3. The minimum amount of water to insure a workable mix was used, normally 5 gal. to a bag of cement with allowance for moisture in the sand and stone. The mixing period was increased from the normal 2 minutes to 3 minutes to secure rapid setting. With this and careful measuring of the ingredients it was possible to start stripping the forms at the starting place as soon as pouring had been completed. Seven men constructed 2100 ft. of curb in about 21 working days. Meantime all old water service pipes, many of them over 40 years old, were replaced with copper; and sanitary sewer laterals that had not been brought to the curb line were installed.

West Pleasant St., Hamilton, 1938

Following this, the old pavement was scarified, bituminous material and good gravel being raked into windrows. Then high points in the subgrade were cut to the desired grade, surplus earth being removed. The windrowed material was then raked back over the 36 ft. width of the road and No. 2 crushed stone used to bring the road bed up to grade. This was thoroughly compacted with a 10-ton roller and an asphalt binder spread over the surface. Up to this point all the work had been done by village workmen, using town equipment. A 2-in. course of Colprovia was then laid by contract (2 in. of coarse material rolled to 1½ in., and 1 in. of fine rolled to ½ in.).

This project, which involved constructing about 350 ft. of storm sewer, 9 catch basins, 2 manholes, 2100 ft. of curb, and grading and surfacing 54 sq. yd. of surface, cost about $7,500, of which $500 will be returned to the village in the form of curbing assessments paid by the property owners.

The successful completion of this first attempt by the village, to spend a part of its highway budget for



Jaeger paver laying crushed stone

highway improvement, was widely commended by the public. In 1938 a somewhat different method was used in improving West Pleasant street. The storm sewers were laid first as they were on Broad street. It was not necessary to scarify the macadam pavement, as the grade and cross section were fairly uniform for all but 450 sq. yd. of its area. In this 450 sq. yd. the grade was cut down and a stone base of 4 inches of number 2 stone was laid, covered with stone grit and wet down thoroughly, and the street opened to traffic while the curbing was being built, this section being wet down two or three times every day. By the time the curbing was completed, the stone base had become thoroughly compacted. Colprovia was again used for the surface. A thickness of 2 inches was used on the stone base, but 1½ inches was considered sufficient over the old macadam pavement. With the exception of the Colprovia surface, all the work was done by 6 village workmen. The total cost of the project, which included 300 feet of storm sewers and 3 catch basins, about 1000 feet of curbing, excavation and stone base for about 400 sq. yd. and about 1400 sq. yd. of Colprovia, was about $2.700, of which about $500 will be returned to the village through curb assessments.

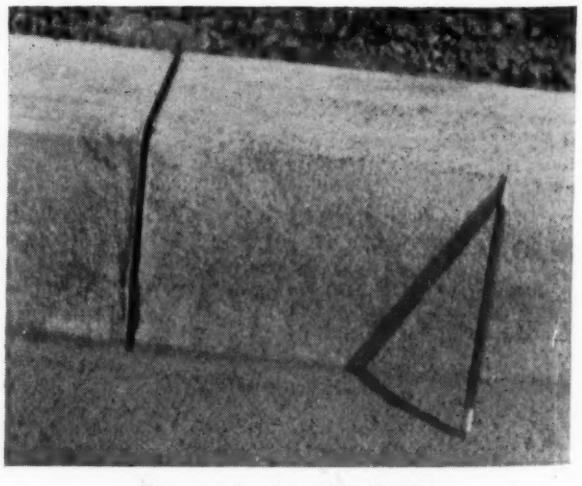
Due to the quality of soil encountered while excavating for storm sewers, it has been found that, when backfilling trenches, best results are obtained by using no water to accelerate the settling and compacting of the earth. In some locations where water has been used ditches have remained in a spongy condition for many months following. On other streets, more backfill is required to fill a ditch than has been excavated. Many types of soil — gravel, blue clay, yellow clay, fine clean sand, quicksand, sandy soil, peat and good ordinary dirt—have been encountered whenever any excavating has been done in the village streets, for which it has been thought advisable in the future to build storm sewers a year in advance of any improvements contemplated for a given street.

An effort has been made by the writer to make all pavements as wide as possible without damage to the trees. On Pleasant street the maximum width obtainable was 25 feet, while on Broad street, 36 feet is the width from curb to curb. If possible, all pavements are made at least 30 feet wide.

As a result of this program, the Village of Hamilton is getting a worthwhile return on every tax dollar spent on its streets. It is reasonable to suppose that, in the not too distant future, a very small portion of the highway budget will be devoted to maintenance, while the bulk of the money will be spent on work of a more permanent nature.

Mixing Processes in the Construction of Tar Macadam Surfacings

The efficiency of the mixing process used in the construction of tar-macadam surfacings has been investigated by the help of the safranine test, which has already been used in similar investigations in the construction of bituminous surfacings. The reliability of the method is increased by the use of an electric colorimeter. Investigation was made into the effect on quality of the resulting mix, of the type of mixing machine used, the speed of the machine, the length of the mixing period, the grading of the mineral constituents of the mortar, the mixing temperature, the presence of moisture and the cleanness of the coarse aggregate. The results of laboratory tests were verified at a large-scale mixing plant in the Ruhr district. The most important conclusions reached are summarized as follows: (1) the coating of the stone with binder is more rapid and satisfactory if the mixing machine is capable of a kneading action; (2) an increase in the speed of the mixer to a maximum of 50 r.p.m. improves the quality of the mixture, but further increase has a detrimental effect; (3) the amount of binder necessary to ensure complete coating of the aggregate varies with the type of tar used and can be determined by the safranine method; (4) given the right amount of binder and a correct mixing temperature, coating should be practically complete after a mixing time of 3 to 5 minutes; a prolongation of the mixing time does not improve the quality. A diagram shows the proportion of stone (3 to 8 mm.) coated at any time during a mixing period of 0 to 8 minutes at a temperature of 40° C., the tar varying between 2 and 6 per cent.; (5) higher mixing temperatures do not improve the quality of tar-mineral mixtures without filler. Pending the issue of an official specification, the safranine test may be regarded as a satisfactory means of measuring the efficiency of the coating of stone chippings with tar. —W. HARTLEB and L. HAUPT: *Technische Hochschule Breslau, Dissertation; Strasse,* 1938, 5 (23), 752.—*Road Abstracts.*



Close-up of curb used at Hamilton

How To Prepare Office Manuals

By JOHN F. PIERCE
Director, Office Service Department
Tennessee Valley Authority

John F. Pierce

Standard practice instructions have application, both in the large organization with thousands of employees in a hundred cities and in the local office with a dozen workers. This article outlines the advantage of such instructions and also the factors to be considered in preparing them.

WRITTEN instructions are effectively used in offices, in factories, and on construction projects. They range in form from bulletin board announcements to detailed manuals of office procedure. The personnel to which they apply may be executives or manual workers. Regardless of use or form, they have as their objective the presentation in convenient shape of the approved practices of an organization or job.

An office manual is a series of instructions so developed and so bound as to provide a usable reference and to allow for revision. In contrast to this are general written instructions issued without plan and solely upon the exigency of the situation.

If an office manual is properly prepared, it is a valuable text and reference. From the standpoint of the training, that part of the manual dealing with organization aids in orienting the new employee. Oral orientation, while necessary, may not give a new man the proper picture of the organization as a whole, whereas a complete organization chart shows the new employee his relation to other members of his group and the relationship of his group to other units; also the function and duties of each unit in its relation to the coordinated activities of the organization as a whole.

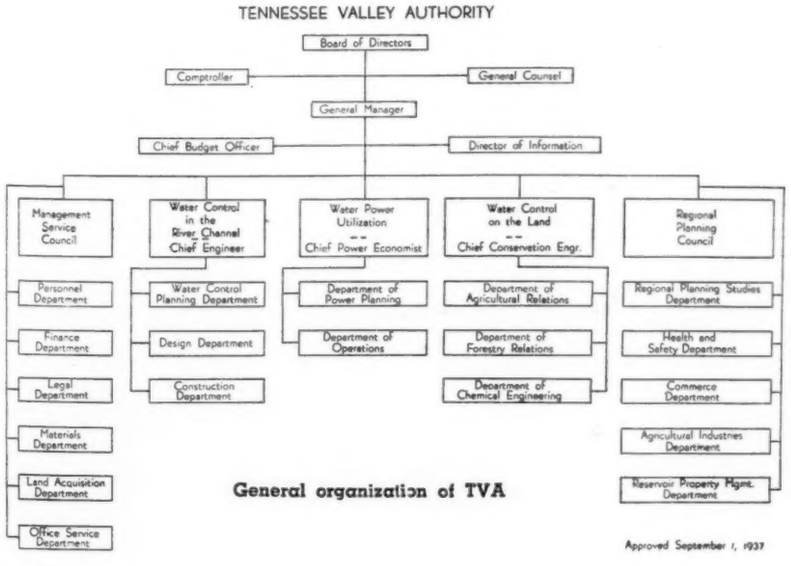
The office manual is an aid in the training of the new employee because it gives him established routines and duties. Instructions change from time to time when presented orally. Written instructions provide a check on unauthorized revisions in instructions and an employee can adopt the instructions set forth in the office manual as the approved and established regulations.

But written instructions, however complete and clear they may be, cannot entirely replace oral instructions. The personal element must, to a degree, enter into job training. The new employee will have questions which will not be answered by written instructions. A demonstration may be necessary.

First among the values of an office manual, however, is that much planning must go into its preparation. This insures that organization will be clarified, that procedures will be developed logically, and that allowance for future development will be made. In itself, this amounts to an inventory of office organization and procedures. Organization and practices may be shown as undesirable and loose-jointed procedures and lost-motion methods may be indicated.

The purpose of a manual is not to regiment employees nor to restrict individual initiative; but to minimize regression from approved methods. Once a correct practice is established and the details are written down, it is more likely to be observed, as the manual provides a means of spot-checking adherence to instructions. This spot check works in two ways: It may show that an employee follows methods other than those approved by his superiors; or it may show that the procedure in effect is no longer the best and that changes must be made.

What the office manual says should be the authority as of a certain date. Providing the manual is kept up to date, an employee can safely rely on it as a reference.



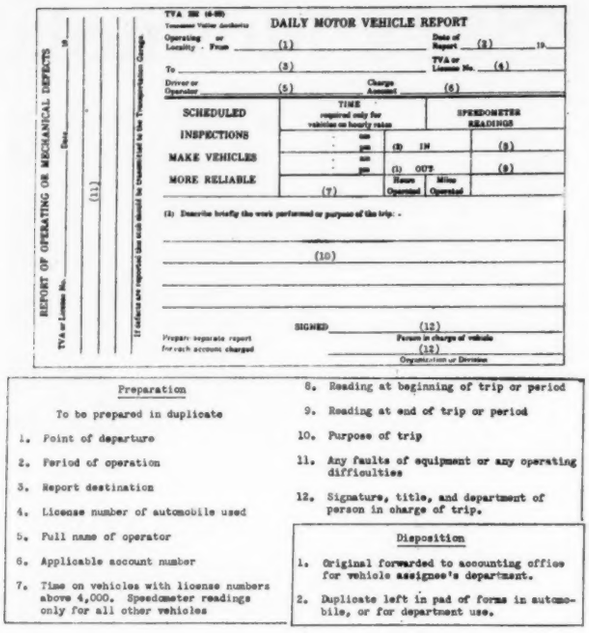
General organization of TVA

What a Manual Should Contain

What the manual will contain will depend on the work and needs of the group issuing it. To be of greatest value, it must give information regarding the policies, organization, and procedures of the group it is to serve.

For the purpose of a coordinated development of written instructions in the Tennessee Valley Authority manual, material was divided into five types: policy, organization, administrative practice, departmental practice, and handbooks.

The Policy Manual consists of resolutions of the Board of Direc-



TVA 388 (6-39)
Tennessee Valley Authority

DAILY MOTOR VEHICLE REPORT

Operating or Locality - From (1) Date of Report (2) 19
To (3) TVA or License No. (4)
Driver or Operator (5) Charge Account (6)

SCHEDULED INSPECTIONS MAKE VEHICLES MORE RELIABLE	TIME required only for vehicles on hourly rates		SPEEDOMETER READINGS
	am pm	(8) IN	(9)
	am pm	(1) OUT	(9)
	(7) Hours Operated	Miles Operated	

(1) Describe briefly the work performed or purpose of the trip: -

(10)

SIGNED (12) Person in charge of vehicle
Prepare separate report for each account charged (12) Organization or Division

REPORT OF OPERATING OR MECHANICAL DEFECTS
TVA or License No. (11) Date 19
If defects are reported this side should be drawn over to the Transportation Garage

Preparation	
To be prepared in duplicate	
1. Point of departure	8. Reading at beginning of trip or period
2. Period of operation	9. Reading at end of trip or period
3. Report destination	10. Purpose of trip
4. License number of automobile used	11. Any faults of equipment or any operating difficulties
5. Full name of operator	12. Signature, title, and department of person in charge of trip.
6. Applicable account number	
7. Time on vehicles with license numbers above 4,000. Speedometer readings only for all other vehicles	

Disposition	
1. Original forwarded to accounting office for vehicle assignee's department.	
2. Duplicate left in pad of forms in automobile, or for department use.	

Form for reporting mileage traveled via TVA or rented automobiles.

tors, interpretations of policy by the General Manager and the General Counsel, and some Executive Instructions from the President of the United States. It sets forth those cardinal principles which govern the administration of the Tennessee Valley Authority both among departments and in the relations of the Authority with state and local governments and agencies and with other governmental departments and agencies. It is broken down into seven parts, each part dealing with a particular phase of the activities of the Authority. Each of these parts is further divided into sections which set forth the policies governing the several departments.

The Organization Manual describes the organization of the Authority. It is broken down, as is the Policy Manual, into seven parts further divided into sections which explain the organization, the duties, and the responsibilities of the various offices and departments. Each section, when complete is made up of these four topics: the Board Resolution creating the office or department, the definition by the General Manager of the duties and responsibilities of the office or department, the organization chart, and the directory of the administrative officers of the office or department.

The Administrative Practice Manual defines and outlines the standard interdepartmental procedures and practices of the Authority. From the standpoint of actual use, the Administrative Practice Manual is by far the most active component of the Office Manuals, for in it are codified the procedures for carrying on the office work of the Authority.

The Administrative Practice Manual is composed of seven parts as follows: General, Office Practices, Office Services, Personnel Services, Travel, Finance, and Procurement Services. These seven parts are further divided into sections: Under "General" is such information as that regarding employee education and training. "Office Practices" includes the instructions relating to correspondence, reports, and the office manuals. Under the title "Office Services" are sections on files, mail, supplies, equipment, reproduction, contracts, and building maintenance. The regulations governing employment, status change, leave, health and medical services. Civil Service regulations, and salaries are included in the part "Personnel Services." Under "Travel" are instructions governing the official travel of Authority employees. "Finance" includes instructions for the preparation and administration of the budget and the accounting procedure for leave and overtime. The procedure for purchasing is set forth under "Procurement Services."

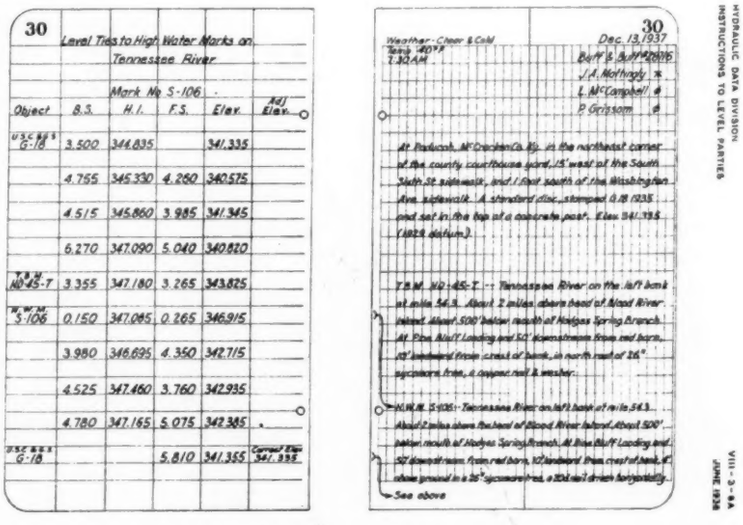
These three divisions of the Office Manuals: Policy, Organization, and Administrative Practice, are all interdepartmental in nature, that is, the material contained in them is applicable to all of the departments of the Authority. For this reason, these three manuals are bound as one volume.

The fourth division is Departmental Practice. These manuals, for there are several of them, deal with the internal policies, organization, and procedures of departments; and the use of any particular departmental practice manual is limited to the department whose policies, organization, and procedures it defines. Departmental Practice Manuals, although developed for a more restricted use than are the first three types of manuals described, must be based on the authority of the Policy, Organization, and Administrative Practice Manuals.

The fifth and final division of the Office Manuals of the Tennessee Valley Authority is what is referred to as handbooks. These handbooks, containing detailed information, are for use in a particular division, section, or group.

At first observation, it might appear that our five types of manuals overlap to a great extent and that they represent duplication of effort. This is not the case. Of course, the Policy Manual does contain some organization matter, but only where such is necessary to the proper delineation of policy. Policy also touches on procedure, and thus on the Administrative Practice Manual, for back of our procedures are policies. At times our Administrative Practice Manual touches on policy, but infrequently.

The Departmental Practice Manuals are so arranged as to include only such material as is applicable to the



30 Level Ties to High Water Marks on Tennessee River

Mark No S-106

Object	B.S.	H.I.	F.S.	Elev.	Adj Elev.
USCE&S G-18	3.500	344.835		341.335	
	4.755	345.330	4.260	340.575	
	4.515	345.860	3.985	341.345	
	6.270	347.090	5.040	340.820	
TVA M 40-45-T	3.355	347.180	3.265	343.825	
W.M.M. S-106	0.150	347.085	0.265	346.915	
	3.980	346.695	4.350	342.715	
	4.525	347.460	3.760	342.935	
	4.780	347.165	5.075	342.385	
USCE&S G-18			5.810	341.355	Correct Elev 341.355

30 Dec. 13, 1937
Weather - Clear & Cold
Temp 20°F
7:30 AM
Party: L. McCampbell
J. Mathiasy
L. McCampbell
P. Grissom

At Paducah, McCracken Co., at the northeast corner of the county courthouse yard, 15' west of the South 26th St. sidewalk, and 11 feet south of the Washington Ave. sidewalk. A standard disc, stamped G.R. 1935, and set in the top of a concrete post. Elev. 341.195 (1929 datum).

T.B.M. M 40-45-T - Tennessee River on the left bank at mile 54.3. About 2 miles above head of Mood River island. About 500' below mouth of Hodges Spring Branch. At the bluff. Leading end 50' upstream from end barrel, 10' landward from crest of bank, in north root of 26" sycamore tree, 4 copper nail & washer.

W.M.M. S-106 - Tennessee River on left bank of mile 54.3. About 2 miles above the head of Mood River Island. About 500' below mouth of Hodges Spring Branch. At the Bluff. Leading end 50' downstream from red barn, 10' landward from crest of bank, at base ground in a 26" sycamore tree, a 30d nail driven horizontally.

See above

HYDRAULIC DATA DIVISION
INSTRUCTIONS TO LEVEL PARTIES
VIII-3-48
JUNE 1938

Desired form of field notes by level parties

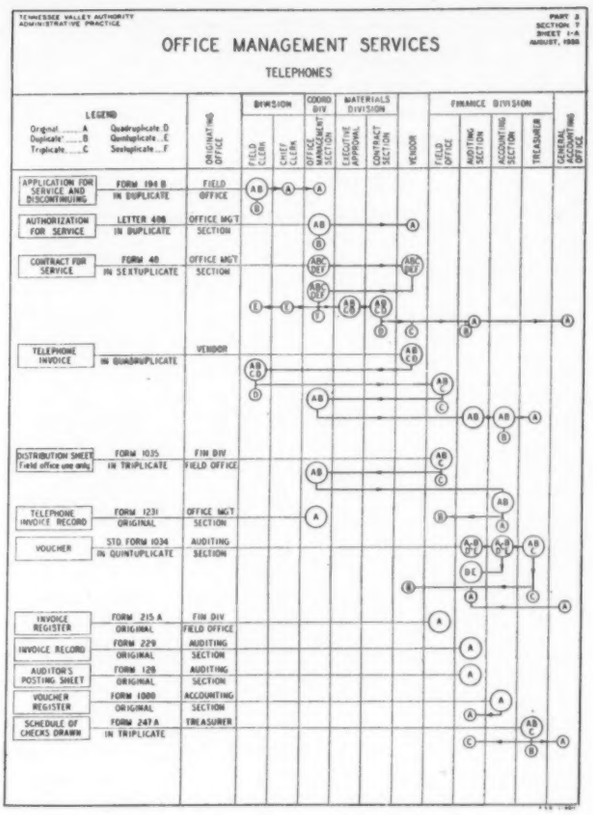
departments they describe. Where necessary, and to avoid duplication, portions of the Policy, Organization, or Administrative Practice Manual may be inserted in a Departmental Practice Manual. The same is true in the case of handbooks.

In the TVA the Office Service Department is responsible for the preparation of office manual material. The manual is developed on the basis of actual practice. The department directly affected by a particular procedure prepares the instructions relating to it and submits this material to the Office Service Department for editing and coordination. Thus the actual assembling of procedural data is effected by the department most familiar with the procedure. The information gathered may be submitted, and often is, as a tentative draft. The editing, arranging, and coordination are done by employees who are specialists in the preparation of written instructions for issuance.

The foundation of an office manual is an outline of the points to be covered. The next step is the gathering of information to fill out the outline. This basic data in the TVA existed in a variety of forms. There were memoranda, bulletins, instruction sheets, handbooks, and the like, all of which touched on policy, organization, or procedures. After this basic material was assembled it was reviewed. All superseded policies, antedated organization charts and directories, and obsolete, conflicting, or duplicated instructions were weeded out.

The procedures surviving this review were taken to be the established procedures, and each was traced, step by step, carefully studied, and refined where necessary. These refined procedures were then set up as the standard practice. The review of procedures demanded that each form used in each routine studied be examined. All records and reports prepared in connection with each procedure were likewise studied. Some forms, as a result of this study, were discarded; others were improved. All important forms were tied in with the written instructions either as exhibits or through descriptions. After the established procedures were coordinated and the forms used were examined, the resulting instructions were the basis of further studies and conferences which led ultimately to the approval of the procedures as codified.

The most important part of a manual, exclusive of its contents, is the manner in which the instructions are codified. Standard instructions are of little value if they are not so arranged as to be readily usable. Some method of internal breakdown is necessary if each procedure is to be immediately available for reference. In the Tennessee Valley Authority Manuals, each manual is divided into parts, which are primary by subject. These parts are mutually exclusive and deal with primary organizations or activities of the Authority. The parts are numbered consecutively within a manual and are designated by Roman numerals. Each part is in turn divided into sections, which are secondary subjective classifications. The sections are likewise developed without overlapping. Each section is designated by an Arabic numeral.

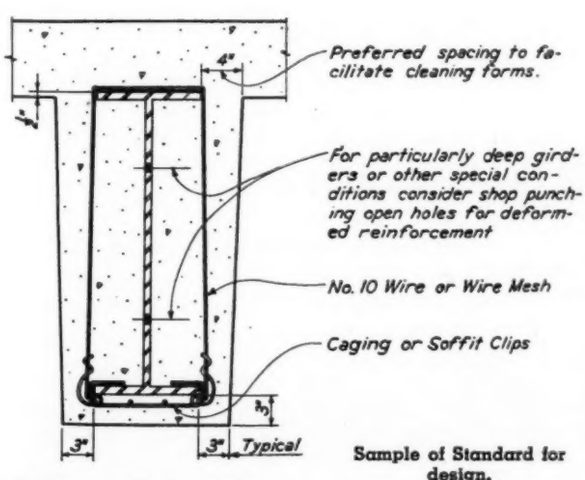


The relation between part and section may be illustrated by these titles: Administrative Practice, Part V, is called "Travel." The title of Administrative Practice, Part V, Section 2, is "Automotive Transportation."

Each section is complete in itself. The pages of the manuals are numbered according to section, each section beginning with page one. Each section deals with one phase of the general activity classed under the part. A change in one section does not affect the rest of the part.

The indexing machinery of the manuals is then composed of part, section, and page. For convenience of reference, each section is divided into topics, each of which is titled with marginal heading, underlined. Each paragraph under a topic is given an underlined paragraph heading. These topics and paragraphs correspond with the topics as listed in an outline.

Four different tables of contents are prepared for the Manuals. There is a table of contents for the complete Office Manuals, one for each manual, one for each part, and one for each section, each successive table being more detailed than the one preceding. The most detailed of all, the table of contents for a section, is in reality a digest of each paragraph in the text. This is to enable employees to gain a hasty knowledge of a section without reading it in its entirety. The table of con-



SPECIAL FIREPROOFING
FOR DEEP SECTIONS

Sample of Standard for design.

tents for a section is printed on colored sheets to aid in reference.

The text of the Office Manuals is as a general rule in narrative form and in the third person. The present tense is used infrequently, and then only in describing tabulated steps in a routine. The simple future is used frequently to describe a procedure, and is in the tone of an indirect command. "Should" expresses obligation, based on expectation, and implies that an undesired result is to be expected if a different procedure is followed. "Must" means that the procedure listed is mandatory. This auxiliary is used infrequently in order that its meaning may not be lost through frequent use.

Positive statements are used, expressed in a cooperative tone. "Don't" is undesirable. Employees are told what they are expected to do. They infer that the contrary procedure is undesirable. The use of the passive voice is also discouraged as it is often awkward. The active voice is clearer and terser than the passive voice.

The text of the Office Manuals is memeographed, both sides of the sheet being used. Where exhibits of forms are used, these sheets are reproduced by a photo-offset process. The sheets of the manuals are punched for a four-post binder, but other forms of binders, so long as they are of a conveniently usable loose-leaf type, may be used. Tabbed index sheets bearing the titles of the parts of the manuals are provided to facilitate reference and to expedite the insertion or removal of sheets.

The advantage of a picture over the printed word is clearly shown by modern advertising methods. Graphic presentation of instructions is equally important. Charts, tables, and illustrations add much to the utility of an office manual or job handbook.

The easiest way to show an employee where he belongs in an organization is to draw a picture of the organization for him. The picture will be no more than a collection of rectangles joined by lines, but it will tell more than pages of text. The type of organization, the relations between departments, the centers of authority, the allocation of responsibilities, the division of functions, the titles of officials, the distribution of personnel, and even the names of employees can be shown on an organization chart, The whole story can be told on one page, and it can be seen at a glance.

Forms procedure charts also cut explanatory text to a minimum. By the use of these charts the proper routing and disposition of all forms used in a certain procedure can be shown. One such chart in the Tennessee Valley Authority Manuals shows the routing of twelve forms and letters dealing with telephone contracts as they are disposed of by eleven offices. Over fifty steps are listed; yet the whole explanation occupies but one page.

Forms play an important role in the office manual. Much of office procedure is centered around forms. With forms occupying this prominence, it is necessary that some means of graphically explaining their preparation be used. In a form exhibit it is not wise to fill out the form with hypothetical names, nebulous places, and imaginary details. In the TVA Office Manuals the form exhibit is filled out with numbers referring to explanatory notes. All the instructions necessary for the preparation and disposition of the form appear on the exhibit. As examples of reports and the like, copies of portions of actual reports serve to instruct employees in the preparation of similar reports.

Keeping the Manual Up to Date

Preparing a manual is one thing, keeping it up to date is another. No manual can ever be regarded as complete as long as an organization is in a state of development. The maintenance of the Tennessee Valley Authority Office Manuals consists of three activities: the revision of instructions when necessary, the distribution of releases, and the conducting of a periodic check to insure the completness and currentness of each copy.

The type of breakdown in the manuals allows the revision of any portion with ease and at small expense. Any page can be changed without affecting the arrangement or numbering of any other page. When the revision is of a minor nature, a page revision is issued. The date at the head of the page is changed, and is followed by an asterisk. An asterisk is also placed in the left-hand margin opposite the change in text, and one before a note at the bottom of the page which identifies the nature of the change. This footnote also gives the name of the official approving the change. If the added text overruns the page, a second page is inserted, numbered the same as the original page but with the addition of a small letter "a" after the numeral.

When a change is required that affects only a word or so, as in the case of the correction of a typographical error or in the addition or deletion of words, a notice of change is issued. This notice instructs the manual holder to make the necessary change with pen or pencil.

No matter how often revisions in manual text are issued, their effectiveness is measured by the promptness with which they are delivered to the individual manual holder and by the instructions given to aid him in their insertion. In the Authority releases are distributed direct to the individual manual holders. Each time a release is issued, a form letter indicating the portion of the manuals affected is prepared. These letters are then addressed by machine to the manual holders, attached to the releases, and mailed. In order to insure the prompt and correct insertion of material, the manual holders are instructed as to which sheets are to be removed from the manuals. Upon making the changes as instructed, the manual holders sign the letters, date them, and return them, together with the superseded pages, to the Office Service Department as a receipt for the new releases. If a manual holder makes an error in the removal of sheets, we can tell where his mistake was made by the sheets he returns, and he is asked to correct it.

The maintenance of the manuals does not stop with the issuance of necessary revisions and the prompt distribution of these releases to the manual holders. There is still another function to be performed in order to insure the currentness and completeness of each copy, and that is what might be called an audit of the Office Manuals. By periodic check list or by personal checking, the completeness of each manual is insured.

There is a future for the office manual in all organizations. This is the day of standard office practices. In order to prevent any regression from standards, written instructions are necessary. These instructions may best be issued as an office manual.

Gasoline Taxes in Europe

United States motorists grumble about fuel taxes (when they are not applied to highway improvement), but they can thank their lucky stars they drive under the star spangled banner. In Italy, drivers pay 53 cts. a gallon for fuel gas tax and duty (total cost, 81 cts. a gallon); in Germany 36 cts. (total 60 cts.); in Bulgaria, 39 cts.; Yugoslavia and Hungary, 26 cts.; Palestine, 22 cts.; Greece, 20 cts. The lowest is believed to be in Norway—11 cts.—the retail price there being 27 cts. a gal.

Regulations for Use of Sewage for Irrigation

THE disposal of sewage, sewage effluent or sludge for irrigation or fertilizing purposes in California requires the holding of a permit issued by the State Board of Public Health. This applies to cities, towns, districts, firms or individuals owning or operating sewage systems. Those who use sewage effluents or sludges are liable, as agents, for the violation of the provisions of such permit or of the public health laws. Sale or disposal of any crop dangerous to the public health is regulated by various state health laws. In order to control health conditions related to the use of sewage for crop irrigation purposes, the California State Board of Health adopted the following regulations

1. *Raw Sewage.* Raw, i.e., untreated, sewage containing human excrement shall not be used for irrigating growing crops. Use of bar screens, grit, or detritus tanks is not to be considered as sewage treatment under these regulations.

2. *Raw or Undigested Sludge.* No sludge or screenings shall be distributed or used for fertilizing any growing vegetables, garden truck or low growing fruits or berries, unless the sludge or screenings shall have been rendered innocuous and free of danger of spreading disease by such measures as (a) kiln drying, (b) bed drying or aging in storage, and in either case for not less than 30 days, (c) conditioning or treating to the satisfaction of the State Department of Public Health. (d) digestion to a point where the sludge or screenings is practically odorless, drains readily and not over 50 per cent of the total solid matter is in the volatile form.

3. *Settled or Undisinfected Sewage Effluents.* Effluents of septic tanks. Imhoff tanks or of other settling tanks, or partially disinfected effluents of sprinkling filters or activated sludge plants or similar sewages, shall not be used to water any growing vegetables, garden truck, berries, or low-growing fruits such that the fruit is in contact with the ground, or to water vineyards or orchard crops during seasons in which the windfalls or fruit lie on the ground. Such sewage, effluents or any sludge or screenings shall not be permitted in ditches or pipes which may be used to irrigate vegetables, garden truck, berries, or low-growing fruit.

Nursery stock, cotton, and such field crops as hay, grain, rice, alfalfa, fodder corn, cowbeets, and fodder carrots may be watered with such settled or undisinfected or partically disinfected sewage effluents provided that no milch cows are pastured on the land while it is moist with sewage, or have access to ditches carrying such sewage.

4. *Oxidized Effluent Highly Disinfected or Otherwise Treated for Bacterial Removal.* The foregoing restrictions do not apply against the use of well oxidized nonputrescible, and reliably disinfected or filtered effluents which always meet the following bacterial standard: in any 20 consecutive samples, from which five 10 c.c. portions each are examined, not over ten portions shall be positive for members of the Coli-aerogenes group, and in no single sample shall over half the 0.10 c.c. portions of the sample of the effluent be positive for the above organisms. Samples shall be analyzed according to the latest Standard Methods of Examination of Water and Sewage of American Public Health Association.

The works and methods used for production of such oxidized and disinfected effluent must be correctly adapted to the purpose and designed with adequate factors of safety to produce uniformly, a well-oxidized, odorless and inoffensive effluent, thoroughly filtered, treated or disinfected to meet the above standard.

For example, where disinfection is employed apparatus and equipment for applying disinfecting agent or agents shall be in duplicate throughout, including machines, weighing scales and reserve supply of disinfectant for each machine. The disinfecting agent or agents shall be kept in separate rooms from the metering mechanism to prevent corrosion thereof. Each room shall be provided with a suitable source of heat so as to prevent interruptions of the disinfection in cold weather. Sewage flow shall be measured and flow of the disinfectant regulated to provide an adequate dose of disinfectant at all times. The feed of disinfectant shall provide an excess over actual needs and be divided between two or more metering machines so that interruption in the action of one will still yield the bacterial results prescribed. Appropriate laboratory tests to show that the disinfection is adequate shall be made at least twice daily. For such routine bacterial control negative 24-hour presumptive tests for the Coli-aerogenes group in the prescribed dilutions will be recognized as sufficient in the absence of other evidence that the presumptive test is insufficient. Proper records shall be kept of actual operations and results. In short, precautions shall be of an order fully equal to those taken by cities using reliable, modern methods of disinfecting water, obtained from a contaminated source of supply.

5. *Cross Connections.* No cross connections shall be permitted between any pipe line or works which may contain sewage, sewage effluent or sludge and any pipe line or works to be used for domestic water supply or drinking purposes. Signs warning that the water is not drinking water should be placed on pipes at ditches, faucets, etc., that may contain any sewage effluent, sewage or sludge.

New Type Paris Green for Culex and Anopheles Mosquito Control

Ordinary Paris Green has a maximum particle size of about 20 microns and the percentage passing through an ordinary filter paper, about 3%. The material used in Ansbacher's subsurface floating Paris Green has a maximum particle size of two microns while around 15% will pass through an ordinary filter paper. However, when the solution is passed through a procelain filter, it is found that the true water soluble arsenic contained is less than one half of one percent. In other words, the subsurface floating Paris Green contains around 14% of colloidal Paris Green measuring one half micron or less and which will keep various waters cloudy from six to thirty-six hours.

The relative toxicity of any arsenical depends on its fineness. The subsurface floating Paris Green has two and one half times greater bulk or volume than standard Paris Green. When dusted on water, it will float on the surface for several hours, then a portion will pass through the surface film and float directly under the film. Some will sink to the bottom. With each disturbance of the surface either by wind or rain, the portion floating under the surface will bob down from one to six inches and then slowly float up to its original position. The water throughout will be cloudy for several hours owing to the colloidal Paris Green contained. The portion floating on the surface film will, of course, decrease with time, agitation, and rain, becoming subsurface floating for a time and eventually sinking, but a very appreciable portion will remain on the surface for more than two weeks.

It is believed that this new development will control Anopheles better than regular Paris Green, and Culex as well as Anopheles, that the poundage used may be lessened and the period between applications extended.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 62 to 65

Progress in Water Purification

(Continued from p. 11)

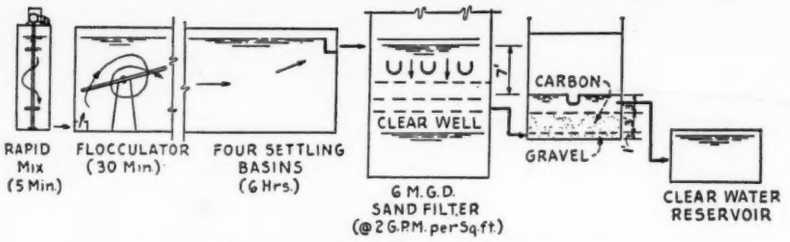


Diagram showing flow through the Oshkosh filter plant

Clay and bentonite are also used to aid in coagulation, or to accomplish coagulation. Atlanta has used adsorbent clays, improving alum coagulation on water of fairly high turbidity, and aiding in the removal of color. Watertown, S. D., found that bentonite markedly reduced the amount of coagulant required with a water that was high in alkalinity and hardness.

Softening and Iron Removal

Probably no other phase of water purification has been more popular in the immediate past than softening and iron removal. Cities and their taxpayers are finding that it costs no more to have soft and iron-free water than it does not to have it; the benefits are paid for whether received or not. The list of water softening plants installed under WPA and PWA would fill many pages; and two years ago there were only 348 softening plants in the country, of which 85 were zeolite plants.

Softening plants differ markedly from filter plants in design but the two can often be combined economically to give complete treatment to the water. The choice between the zeolite and lime-soda processes depends almost entirely on local conditions. For the latter, a satisfactory means of disposal of the lime sludge must be available. Studies have been made of the problem of recovering the lime from this sludge and using it over again, but a difficulty is that the sludge contains other materials. Various procedures are described by Aultman[6]. An excellent discussion of water softening plant design by Knox[7] covers mixing, sedimentation, chemical feeding, etc.

Zeolite softening will remove about 3000 to 4000 grains of hardness per cubic foot of zeolite, and for regeneration about 0.4 lb. of salt is required for each 1000 grains of hardness removed. Zeolite can also be used for manganese removal, and about 1.5 lb. of potassium permanganate is required per pound of manganese removed. At Sarasota, sea water has been used for regenerating a zeolite used for softening the municipal supply. The sea water is first chlorinated, then coagulated and filtered; then used for regeneration and backwashing. The entire plant is automatic—softeners, sea water filters, etc. The operating cost is very much less than for any other method.

With the development of the carbonaceous zeolites, also called hydrogen zeolites, ordinary zeolites are now called sodium or siliceous zeolites, because they are regenerated with sodium and contain 40% to 60% silica. The hydrogen or carbonaceous zeolites are made from coal, lignite, wood, etc. by treatment with sulphuric acid. These can be regenerated with either salt, to act as a base exchange, or with acid to act as an acid exchange. Thus, these zeolites are applicable for softening waters, if operated in the sodium cycle, exactly as the ordinary sodium zeolites, and are said to have an exchange capacity of 5000 to 8000 grains per cubic foot operating as a sodium zeolite. They are applicable for the removal of sodium bicarbonate or calcium and magnesium bicarbonate, in which case regeneration is accomplished with a weak acid, as 1% sulphuric. These hydrogen zeolites can be used for the recarbonation of lime-softened water or for maintaining a constant alkalinity.

Iron is removed by contact-type filters, by aeration, or by the use of lime. Prechlorination may be used to control iron bacteria prior to treatment. There are also several special proprietary compounds—Ferec, Elconite and Birm—for removal of iron. Also zeolites remove iron in softening, and special zeolites are available.

When lime is used to remove hardness, recarbonation or other treatment is necessary to prevent the excess lime from precipitating or depositing on the filter and coating the grains, and also from forming deposits on the inner walls of the piping system. "Threshold treatment" is the term applied to the use of a small quantity of sodium hexametaphosphate for preventing this precipitation or deposition of the lime, that is for stabilizing high carbonate hardness water. This material does not change the pH of the water and acts independently of the alkalinity or pH through its surface-active properties. The procedure may be termed "sequestering" the alkalinity. Only small amounts are necessary, probably from 0.5 to not more than 2 ppm. The formula of sodium hexametaphosphate is $(NaPO_3)_6$. Cost of treatment is around $1 per mg. Its use permits water with pH values of 9.5 or higher without depositing lime, thus preventing corrosion.

Sodium silicate has also been used for preventing corrosion of pipes by water low in calcium and high in CO_2. Added in small quantities, it forms a thin coating on the interior walls of the pipe.

Carbon dioxide reduction or neutralization to reduce corrosion is accomplished either by the use of lime or by passing the water through beds of limestone. A contact period of 3 to 4 hours with limestone reduces CO_2 and increases pH and alkalinity; also hardness. Iron is also removed.

The magno filter is a German product regarding which some information is available[8], [9]. It reduces acidity and increases the calcium content of the water; it also can be used for removing iron and manganese.

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When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 62 to 65

Recent Developments in Water Purification Equipment

EVERY year sees some developments in equipment used in the treatment of water. Some are only changes (presumably improvements) in equipment already in use; others are devices for putting into practice ideas worked out theoretically or in the laboratory; while some are entirely new in function so far as treatment of potable water supplies is concerned, although many of these are adaptations from the industries. There are many features and functions common to the treatment of both water and sewage, and a number of devices used originally for sewage have been adapted, usually with some minor changes, for water also. (An illustration is the sludge collector, for water sedimentation tanks.)

Flocculation paddles embody an idea known in the laboratory before it was utilized in the field. Recent developments in this are the "Floctrol," "Vari-Speed" mixer and "Slo-Mixing" equipment, by which the agitation of the water by the paddles decreases progressively as it flows from inlet to outlet of the tank or through a series of tanks.

The flocculated matter is settled out in a sedimentation tank, and the two tanks—flocculation and sedimentation—are combined in one rectangular tank in the "Squarex," or in two concentric round tanks of which the middle one is used for flocculation.

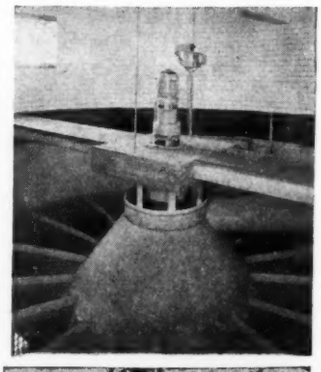
In precipitation, the most notable recent development has been that embodied in the Spaulding precipitator and the "accelator," intended primarily for clarifying the water in a softening plant. In these the combined chemical and water pass downward through a central cylinder or cone, in which they are mixed by a paddle, leave through an annular space at the bottom, and deposit the sludge there, the clarified water overflowing at the top of the outer cylinder. The passing of the water through the accumulated sludge produces a more stable effluent and more complete utilization of the chemical.

The salt used for regenerating a zeolite filter should be free of impurities. Instead of using so-called evaporated salt, the salt can be freed of impurities by "Lixate" apparatus, which delivers pure brine to the filter, the sludge being drawn off from the bottom at intervals.

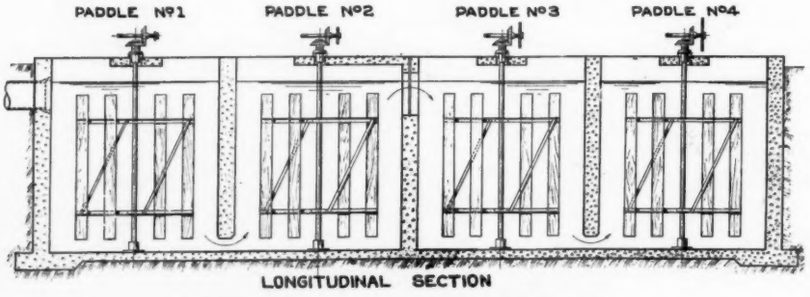
In filter plants new details are appearing from time to time. For pressure filters (commonly used for swimming pools) a "tri-filter" valve is offered, a single valve regulating the flow of water to and from a set of three filters; or a "multiport" valve controls all inlets and outlets of a single filter. Automatic control of a zeolite softener is effected by use of a single multiport valve driven by a small electric or water motor, connected to electrical controls, which rotates the valve to its successive settings, the intervals of rotation being adjustable so as to begin washing when the predetermined amount of water has been filtered, supply wash water at the desired rate and for the desired time, apply the desired amount of brine, then the desired rate and amount of rinse water is applied, and raw water turned into the filter again—all without any attention from the operator.

Similar automatic operation of a gravity filter is obtained by use of the "Robotrol." When the head on the filter reaches a height indicating the desirability of washing, it throws a switch which sets the device in operation; the inlet and outlet valves are closed. washwater valve opened and kept open for the desired period, while a rate controller maintains its flow at the desired rate; then the washwater valve is closed and the filtering valves opened.

It is generally considered that the volume and rate of washwater should be such as to cause the filter sand to expand a certain amount (commonly 50%). To aid

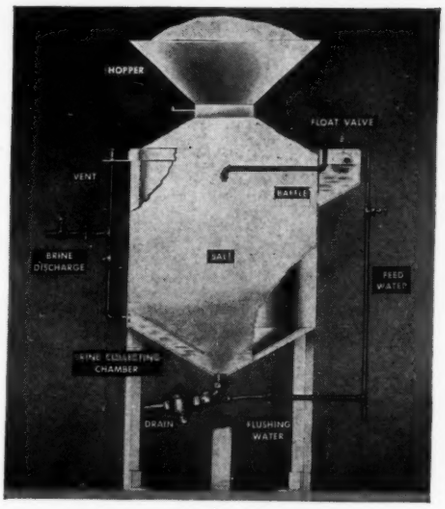


At the right are two new Permutit developments: The Spaulding Precipitator, above, and the Floc-former, below



Link-Belt Vari-Speed Mixer for flocculation tanks

Note: All tanks may be operated in series or tanks 1 & 2 and 3 & 4 in series and the two units in parallel. The circumferential speed of paddle No. 1, 1.8 FPS., paddle No. 2, 1.4 F.P.S. and paddle No. 3, 1 F.P.S. and paddle No. 4, 0.9 F.P.S.

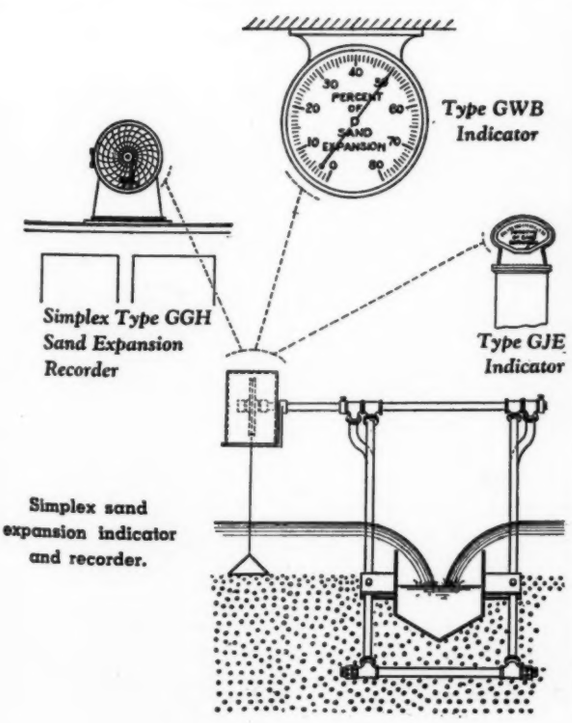


How the Lixate process works

in detecting the amount of expansion obtained, a sand expansion indicator is obtainable—with a recorder if desired. This consists of a small conical float so counterweighted that it is lifted by the rising sand, the counterweight cord passing around a wheel which it turns, which turning is transmitted to the indicator, which translates it into percent expansion.

The "rotameter" is being adapted to several devices —among them a chlorinator and a "Testerate indicator" attachment to a meter tester. This consists of a rotor (shaped like a boy's top) inside a vertical glass tube which is slightly but accurately tapered. Any fluid passing up through the tube must pass through the annular space between it and the rotor, and the greater the amount the larger the annular area and consequently the higher the rotor is lifed. A gauge alongside the tube permits translating height of rotor into quantity of fluid rising past it.

A continuous record of the rate at which chlorine gas leaves its cylinder can be obtained on a circular chart by means of a "chloroscale," or of a "printomatic" on a

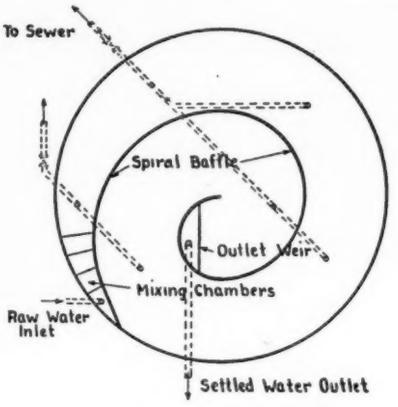


Simplex sand expansion indicator and recorder.

roll tape, attached to the scale on which the cylinder stands.

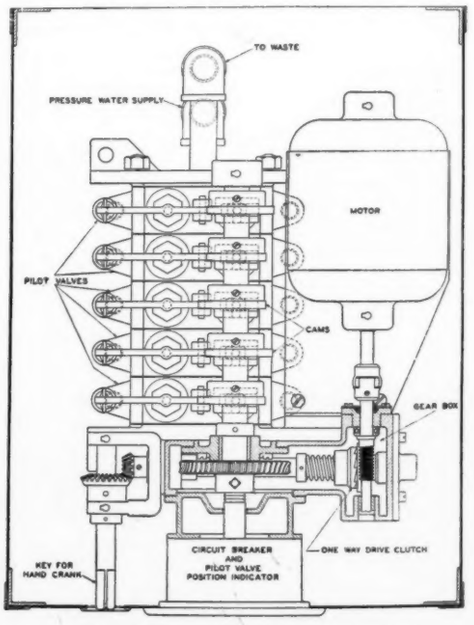
In order to maintain the chlorine dose which will give a uniform chlorine residual in the effluent, Los Angeles uses a "residual chlorinator," which automatically makes a residual chlorine test colorimetrically every 3 minutes and adjusts the chlorine dose accordingly by means of a photoglow tube.

Gravimetric feeding of chemicals is being adopted by an increasing number of plants, and improvements are being made in gravimetric feeders by several manufacturers. In one type a belt conveyor is mounted on a scale so that this records the amount of chemical on the belt. As the conveyor, which receives the chemical from a feeder, moves continuously at a uniform rate, the rate of feed bears a fixed relation to the



PLAN SHOWING GENERAL ARRANGEMENT OF SPIRAL BAFFLE SEDIMENTATION TANK

amount on the belt at any instant. Should this be less or greater than desired, the scale arm rises or falls and adjusts the rate of feed onto the conveyor. In another, a batch type, the hopper from which the chemical is fed is supported on a scale mechanism and each time it is filled the scale is balanced manually. A motor moves the poise backward at a fixed rate, and if the chemical is fed at a rate that does not correspond to this, the movement of the scale beam adjusts the feeding mechanism.



Permutit Master Pilot Valve assembly

Copper Sulphate, Fish and Flora

Recently an ardent bait-caster sprung the idea that fish do not bite following copper sulphate treatment—well, here's what an expert says. According to "Over the Spillway," publication of the Illinois Division of Sanitary Engineering, Dr. David H. Thompson, Zoologist of the Illinois State Natural History Survey, wrote:

"For many years I have been familiar with reservoirs in which copper sulphate is used to control algae. I understand that the purpose of this control is primarily to do away with a number of disagreeable tastes which are often given to water by algae. It also facilitates the clarification of the water. In a few instances water containing heavy growths of certain algae is actually poisonous when it is drunk. The dosages commonly used are one part per million or less. I know of no instances where this dosage has destroyed adult fish. I have heard laymen complain that copper sulphate destroys spawn and newly-hatched fry. There may be some basis of truth in this, although the problem is not an important one, since most Illinois reservoirs are already overstocked with the common kinds of fishes.

"I, too, have heard that fish do not bite in certain reservoirs after they have been dosed. This may very well be true, although I should like to point out that certain lakes maintained for fishing by clubs are regularly treated with copper sulphate to hold down the algae. Some of the lakes which have been treated in this way two or more times each summer over a period of many years furnish about the best fishing in the State.

"At Lake ———— there have been repeated complaints during the past few years that excessive dosages of copper sulphate have killed off the coarse, rooted aquatic plants. These plants are important to the production of fish, since they support quantities of worms, snails, leeches, insect larvae, etc., which make up the bulk of the food of fishes in such places. While one part per million ordinarily does not injure these coarse plants, there is some likelihood that the copper sinks and forms abnormally high local concentrations which can do it. I believe there is no reason to destroy these plants when they are present in moderate amounts, since I have not heard that they ever impart undesirable flavors to the water or to the fish."

The Mechanical Analysis of Fine Powders

A critical survey is made of methods for determining the particle size of powders finer than 0.1 mm., for which sieve analysis is not possible. Microscopic measurement and adsorption are dealt with, and particular attention is given to the methods depending on the velocity of fall of particles in a viscous medium, which include elutriation and various sedimentation methods, among them the Wagner turbidimeter and the flourometer. The sources of error in sedimentation tests are discussed and a description is given of a method of sedimentation devised by the author. The powder, after dispersion in liquid, is placed at the top end of a long tube of 60 mm. dia., filled with clear liquid. The particles, after settling in this tube, are collected in a graduated conical base. The effective particle size is then calculated from Stokes' formula. Experiments on the same powders are stated to repeat within 3 of 4 per cent. The results obtained by this method are compared with those obtained using the flourometer and the Wagner turbidimeter, and good agreement is found. Acetone is stated to be very suitable for sedimentation of the finer powders. A bibliography of 20 references is given. PROT: *Ann. Ponts Chauss.*, 1938, 108 (1), 94-118. Road Abstracts.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

Standby Power for Pumping Stations

For large cities, supplementary electric power lines are usually best; get an exclusive line if possible and test line frequently. For plants of less than 25 or 50 hp., the best may be complete engine-driven electric generating units, not automatic in operation but as simple as possible. For the majority of plants between these sizes, the best may be direct-connected engine-driven pumps, using gasoline, gas or diesel engines. Most applicable to emergency service is the gasoline engine resembling the automobile or motor-boat engine; can be placed in operation quickly and tested weekly. Keep plenty of fuel in storage—say one pint per horse-power hour. The emergency engine should furnish the lights and perform all the other services required about the plant. Up to 200 h.p. the cost is approximately $15 per h.p., but above this about $25. A diesel unit costs three or four times as much as a gas engine unit but can operate on one-quarter the fuel cost with very little maintenance cost; and is immune to conditions that may affect electric, steam or water power; but its first cost is not warranted for emergency purposes alone.[B18]

Increasing Efficiency of Water Systems

Decrease amount of non-revenue producing water. Decreasing leakage is less important than is generally assumed. More important but receiving less attention are illegal use through fire lines, unauthorized use through hydrants, under-registration of meters. The author believes every system should be 100% metered and have a master meter, and balance the readings of the two every month. Leave no meter in service that registers less than 95% of the water passing through it. Get heads of fire, police, public works and other departments to cooperate. Watch for unauthorized use of hydrants. Keep a close check on private fire lines. Look out for leaks. Install gauges that will show, by pressure, rates, etc. what is happening in the system. Secure aid of city officials in eliminating special privileges and discrimination—all a matter of organization only.[A94]

Corrosiveness of Copper Service Pipe

Ordinary food as popularly eaten in one day contains about 1 mg of copper, and up to this amount copper is probably beneficial. The principal objection to copper in a domestic supply is the possibility of causing green stains on wash basins, clothes washed in it, etc. Corrosiveness of water for most non-ferrous metals is believed due to the presence of more than 17 ppm of carbonic acid; also possibly to low pH. Either of these conditions can be corrected by simple treatment of the supply. Or corrosion of copper pipe can generally be prevented by tinning the pipe, which is becoming common practice. Type K copper tubing tinned inside and out costs about 25% less than untinned brass pipe of the same size.[B20]

Wholesale Cost of Water

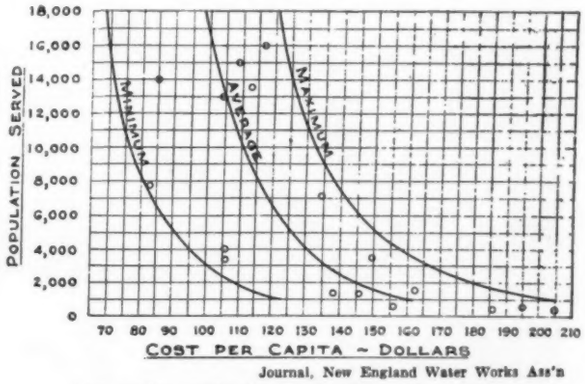
In most cases the true cost of water supplies is greater than is realized and charges for water are too low. With increasing prices and wages, costs are increasing. Wholesale operating costs of 60 cities from 101,000 pop. to 7,590,000 vary from $4 to $68 (most between $10 and $40) with a general average between $20 and $25; greatly dependent on type of supply and usually lowest for large gravity supplies from impounding reservoirs. Total wholesale costs (including fixed charges and depreciation) average about $70 per mg. With rising construction costs, this average is rising to $80 or $100—unquestionably higher in some instances. Distribution cost will increase this by approximately $45. The cost of the distribution system varies approximately with the size of the municipality, averaging as follows, expressed as percentage of the cost of the entire work: 5,000 population, 23%; 10,000 pop., 27%; . . . 500,000 pop., 60%. There is still to be provided in the selling price the cost of clerical work, maintenance, etc.[A93]

Corrosion of Pipes and Bacteria

The presence of ammonia and oxygen as a source of energy for bacteria gives rise to bacterial growths in mains; and bacterial transformation of basic ammonia and oxygen to acidic and oxidizing nitrites and nitrates enhances corrosion. Corrosion that takes place in a system as a whole is magnified by the accumulation of traces of the iron in the gelatinous masses of bacterial growths clinging to the pipe where velocity of flow is low and sloughing off occasionally.[A100]

Estimating Costs of Small Supplies

From comparisons of costs of a number of small New England surface supplies, Sampson concludes that approximate estimates of costs are best based on the per-capita-served unit, rather than number of services or daily capacity. (K. R. Kennison contends that the last is the only satisfactory unit.) In using past costs as a basis, adjust for great changes in unit costs during the past 30 yrs. In 1914, cost of water works was only about 48% of 1937 cost; while in 1920 the cost was 130.5% as much; and another low of 78.3% was reached in 1932. Estimates based on 1937 prices, average conditions, c.i., b & s., bitumastic-lined, centrifugally cast pipe, lead substitute joints, gave an average price of $1.93 a lineal foot ($1.96 if 6" is the smallest pipe used). Lengths of mains varied from 6 miles for 1,000 population to 76 miles for 18,000. Add: for specials, 4.5 c. per foot of mains; for rock in trenches, 15 c.; valves & boxes,



Journal, New England Water Works Ass'n

Per capita costs of small waterworks plants

8 c.; hydrants, 17.5 c.; total average cost per foot, $2.38. Cost of services, non-corrosive pipe, cocks, etc., $38 each, $9 per capita. Add for replacing pavements, river or railroad crossings, preliminary and legal expenses, etc. The costs of source of supply, treatment, secondary storage, etc. vary greatly, ranging from $10 to $60 per capita, averaging $23. (For this, a cost unit of million gallons daily capacity would give more uniform results.)

The author has computed, on the basis of the above, the 1937 cost of complete systems for various populations, shown by the accompanying curves, the circles showing actual costs (reduced to 1937 prices) of 17 systems.[B11]

Filter Construction in a Cold Climate

In building a filtration plant at Biddeford, Me., a 1.2 m. g. sedimentation basin was built open for inspection, and completely housed in. A previous basin had caused trouble by freezing, and in addition to housing, the temperature in the basin is maintained above freezing at all times by means of steam heaters. (This basin reduces the bacteria count 66% before filtration.) In construction of the filters, no water-retaining walls were exposed to the outside air, but the foundation walls of the enclosing building were built 8″ outside the walls of the filters and clear wells, giving an air space of this width. This is expected to obviate the difficulty caused by seepage and consequent ice formation and disintegration of concrete experienced in many similar structures in that climate.[B15]

Controlling Tastes and Odors

The New Haven, Conn., Water Company has 11 reservoirs in service at all times, 2 of them storage, 9 supply. Previous to 1930 there was trouble from tastes and odors due to algae; since then, when a control procedure was adopted, these have occurred only 5 times, two of which were due to human shortcomings, the others probably to algae growths in the mains. The procedure is to analyze samples taken weekly near the gatehouse at the level from which the water is drawn. If analyses show a sudden increase in algae, copper sulphate is at once applied; also if there is a slow but continous increase. Results of analyses are ploted on a chart, a different color of line for each of the 6 types of algae that are found to cause tastes in these reservoirs—Asterionella, Tabellaria, Dinobryon, Uroglena, Synura and Anabaena. The first two generally occur from November to April; the third in May, June, September and October; Uroglena and Synura in late spring and early fall. July and August are free from all types.

The amount of copper suphate used is 2 pounds per mg of water. It is applied by dragging in bags from boats. It has been found that 1,000 units of Asterionella or Tabellaria, singly or combined, will give taste and odor. No method has been found of reducing taste and odor when the water is too cold to dissolve the copper sulphate efficiently, but chlorine-ammonia treatment seems promising.[B17]

Sewage Pollution of Niagara River

Before Buffalo purified its sewage, the bacterial pollution it contributed to the river remained within a definite zone, not more than 30% of the total flow of the river, the boundary line of which varied only with strong winds. The coliform content increased for a number of miles and was still in evidence 19 miles (12 hours) below the city, there being apparently some growth cycles within that distance. The total coliform content of the river in warm weather exceeded 15,000 quantity

units; approximately 400 billion passed per second 7 miles below the city. Winter numbers were about one-third as great.[A98]

Economy of Vibrating Reservoir Concrete

In building a covered reservoir in Darlington, England, columns 18″ square were tamped some by hand and some by internal vibrators. Each column was poured continuously for its full height. Comparing the two methods, it was found that: *(a)* 4.25 per cent more concrete was used when mechanically vibrated. *(b)* One man less was required when vibrator was used, and, *(c)* the time for pouring one column was reduced from forty minutes to twenty-five minutes.

It will be seen, therefore, that a saving of 1.16 man-hours per column was made. In addition, the time spent on rubbing down the concrete after striking the forms was greatly reduced, as very little finishing off is required when the vibrator is used.[D25]

Bacteria in Lakes and Reservoirs

Studies of growth and distribution of bacteria in a large lake apparently indicated that there was very little difference in bacterial numbers at similar depths in deep open water over a distance of 4 miles, but in shallow areas near shore the content was much higher and more variable. The vertical distribution was more complex and variable, especially during the overturn.

The amount of rainfall preceding a weekly sample showed a striking relationship to the number of bacteria, a rise in number occurring 2 to 4 days after the rain. Why was not determined. The rain itself contained less bacteria than the lake water. Soil bacteria washed in were apparently not responsible—there were no more near the inflow than further out and the number of soil bacteria did not increase after the rain. More probably the increase was due to a multiplication of types existing before the rainfall. No reason for this has yet been proven.[D26]

Comparison of Compound and Battery Meters

The Hartford, Conn., Water Bureau, testing registration of a 3″ compound meter and three 1½″ disc meters, and a 2″ compound with three 1″ meters, concluded that, with all meters of proper size and in good condition, the battery of disc meters will record from 2 to 5% less consumption than the compound meter. But this is probably affected by variations in uniformity of consumption rate.[G27]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

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94. Increasing the Efficiency of Water Systems. By A. T. Cook. Pp. 1110-1123.
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103. Water Supply Safety Control: British Ministry of Health Memorandum. Pp. 1215-1225.
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J *American City*
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12. *p.* Les Systemes Nouveaux d'Assemblage pour Tuyaux de Canalisation, Brauchements et Robinets-Vannes. By E. Berriat. Pp. 81-87.
13. *p.* Observations Generales sur l'Hydrogeologie du Bassin de l'Aquitaine. Pp. 88-89.

The Sewerage Digest

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

Designing Diffused Air Systems for Activated Sludge

Providing compressed air for an activated sludge plant costs more, in 2 to 5 years, than the first cost of the entire air system. From 10% to 35% of the cost is due to pressure losses in piping and diffusers. Pressure losses are reduced by increasing sizes of air pipe and number of diffusers. In Chicago there was little increase in efficiency of treatment by increasing the number of rows of diffuser plates from one to four, but the air pressure required was reduced. To reduce annual cost to a minimum it is necessary to consider first and maintenance costs and useful life of different numbers of diffuser plates per tank (allowing for loss of permeability that occurs by use), the cost of supplying the required amount of air under the different pressures, and the same with respect to different sizes of air piping; the unit air cost being the annual cost per cu. ft. per min. of free air per lb. of pressure per sq. in. Theoretically an air piping system can be designed that would give equal pressure to all the diffusion plates without throttling the plate connections, but this is not practicable since standard sizes of pipe must be used, and throttling of valves on the plate connections seems to be the practicable solution, especially in securing "tapered" distribution of air.[G27]

Scrubbing Gas for H_2S Removal

In Chicago Heights, Ill., H_2S in the digester gas (about 100 grains per 100 cu. ft.) caused pitting of the gas engine, clogging piston rings, forming sludge in the crank case oil and clogging small air lines. This has been eliminated by passing the gas through scrubbers containing iron sponge (wood chips coated and impregnated with hydrous oxide of iron). The sponge must be kept moist. When it loses its efficiency it can be revivified by removing it and exposing it to air. Experiments are being made in revivifying it by adding ammonia water to the sponge without removing it. Sixty thousand cu. ft. of gas containing 100 grains of H_2S per 100 cu. ft. can be removed by one bushel (1.25 cu. ft.) of sponge between revivifications, which can be repeated two or three times. Sponge has cost 1.5 cts. per 1000 cu. ft. of gas purified, without any allowance for labor.[G28]

Rainfall on Small Areas

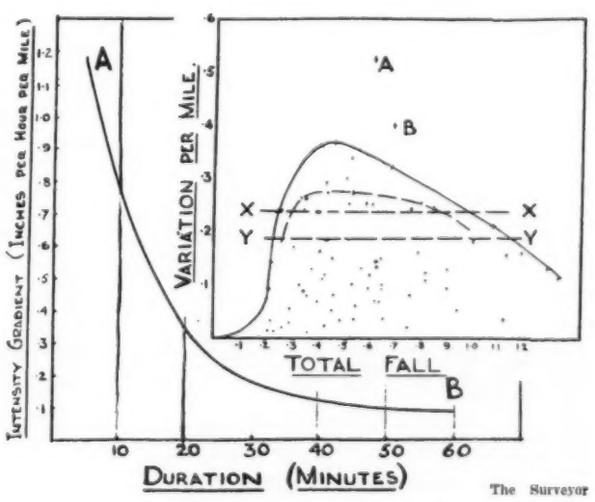
A rain gauge may very inadequately indicate the rainfall over even a small area. In one case two gauges 1.4 miles apart varied 100% in indicated total rainfall. The smaller the number of gauges in any one area, and the smaller the area embraced, the less the probability of the maximum intensity in any one storm being recorded. Recording maximum intensity necessitates the eye of the storm passing over a gauge. The shorter the duration of a storm and the more limited its extent, the greater the probability of its maximum intensity being recorded in the area affected. The difference between the readings of two gauges for a given storm, divided by the distance between them, is called the "gradient" for that storm. In the author's studies maximum gradients of 0.5″ occurred for 0.5″ total fall; 0.1″ for 0.2″ total fall or for 1.4″ total. A steep gradient gives a much lower total rainfall over the entire area and much less sewer flow than a gauge at the eye of the storm of high intensity would indicate. The intensity gradient of short storms is steeper than that of longer and more widespread falls. If a storm should follow the route of a sewer, the effect would be approximately the same as though the rate were uniform throughout the area. In general, the allowance for intensity gradient of a storm would vary with its duration. A curve based on a number of English storms is shown in the illustration below, from which average gradients for Cambridge could be obtained. (Such a curve for different American localities would probably vary widely from this.)[D41]

Frequency of Sludge Pumping

The Yakima, Wash., treatment plant contains three 40 ft. digestion tanks, two used as primary and one as secondary. Sludge is pumped to the former from four settling tanks and mixed with the previous contents. Only the thickest sludge is pumped from the clarifiers; ordinarily 5 min. of pumping from each clarifier at hourly intervals from 8 A. M. to 9 P. M.; but the sludge being pumped is watched closely and the intervals varied accordingly. The primary tanks reduce the volatile matter 66% and the secondary tank an additional 14%; the total reduction of total solids is 63.8%. The solids loads handled, based on primary digestion capacity, was 3.0 lb. per cubic foot per month. The supernatant averaged 390 ppm suspended solids, 1,985 total solids, 800 5-day B.O.D.[H41]

Left — Intensity gradients for rains of different durations. (From Cambridge, England, data.) Decrease in rainfall intensity with increased distance from the "eye," or center, of the storm; amount of decrease (in inches per hour) per mile of such distance—is much greater for long than for short storms.

Right—Records of storms during 10 years and curve including maximums. Relation between total rainfall of a storm and the intensity variation per mile.



The Surveyor

Treating Chromium Plating Wastes

Chromium plating, a comparatively recent industry, produces wastes that have caused trouble in a number of sewage treatment plants. In one, wastes from copper and nickel plating had been received for ten years without causing trouble, but soon after chromium wastes began reaching the sewer the filters ceased to do any biological work whatever, and the beds were found to be absolutely sterile. The crude sewage contained from 3.5 to 67.6 ppm of chromium, the effluents 1.7 to 27.7, these being composite samples undoubtedly exceeded at times; the lower effluent content being due to the effect of night flow. The wastes are now being treated at the factory by the addition and mixing of barium chromate and adjustment of the final pH to not less than 7.5. The pH adjustment is made with sodium carbonate which was already in use at the factory. Each day's discharge is received in one of two tanks, tested for the amounts of chemicals needed, which are added, mixed with compressed air, allowed to settle over night, and the supernatant drawn off gradually next day. A liquid containing only 1 ppm is being discharged into the sewer.[D40]

In some cases chromium wastes have caused clogging of sewers. Here the wastes from one factory contained up to 173 ppm of chromium. Suggestions of the cause of clogging were decomposition of soaps forming a sticky mass of free fatty acids, and the pronounced precipitating effect of such wastes.[D38]

Sludge Banks in Impounded Water

The effluent of a trickling filter averaging 1.46 cfs has been discharging for 8 years into a reservoir formed by damming a stream of 8.0 cfs flow and having a capacity of 15 mg. The total sediment accumulation has been 23 cu. ft. per ton of sewage solids per year, of which only 3.9 cu. ft. was sewage solids, the rest is natural silt accumulation and decaying vegetation. These composite deposits differ from those not sewage-polluted principally in having a higher B.O.D. though sufficiently low to prevent nuisance. Also the volatile content was higher but the destruction of volatile matter was 93% within a relatively short time. Nitrogen, pH and solids were practically the same in both.

There was a significantly higher degree of decomposition in the bottom layer than in the top. Horizontally the deposit was practically uniform. There was a persistent oxygen demand by the older material (potential rather than active) which is decreasing but constituted 40% of the total demand of the entire deposit; believed to be due largely to the more resistant nitrogenous plus remaining carbonaceous material.

There was almost complete absence of protozoan forms, and only about 10,500,000 and 8,800,000 bacteria per gram of organic material in the top and bottom strata, respectively. (Fertile soils may have 8 to 10 million).

The conclusion was that impounded bodies of water, operating under natural conditions, offer a capable unit in the process of sewage purification, with respect to reduction of B.O.D., suspended solids and B. coli, and decomposition of settleable solids with less oxygen demand on the stream.[C51]

Recovering Paper Mill Fibre

Mills use 30,000 to 50,000 gal. of water per ton of paper board manufactured, and the waste water carries about 3.5 lb. of suspended solids per 1,000 gal. If recovered, this would be worth $10 to $12 per ton. Dorr Co. engineers suggested a large sedimentation tank for recovering paper fibres but reported no method known for recovering stock

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from straw mill waste water. From investigations for a Michigan plant the author concluded that mechanical screening using revolving screens covered with fine-mesh cloth is effective and might prove profitable. The practical limit of such screening seems to be 1 to 1.25 lb. per 1,000 gal. of water. Separation of straw mill waste is very difficult if not impossible by this method, unless such waste water be mixed with that from a paper board mill or similar waste.[C52]

Laying a Subaqueous Outfall

Ypsilanti, Mich., laid 24 40 ft. lengths of 16″ steel pipe for an outfall sewer in a shallow lake using 3 men for 13 8 hr. days; a crane with a half-yard dragline bucket, a barge, a raft with a chain fall at each end, and two cribs 15 ft. square by 5 ft. deep. Seven lengths were coupled up and floated into place over a trench dug to grade by the dragline, and lowered into it by flooding. Then the raft was stationed over the last length and raised the end above the surface, another length was coupled on (Dresser couplings were used) and held above the surface by the crane while the raft moved ahead to support it; and so on length after length. The crane was supported on one of the cribs about 17 ft. from the pipe line, swinging the other crib into place ahead and rolling onto it when moving ahead. It excavated the trench for each length of pipe as it was lowered, dragging across the trench; handled the pipe; and backfilled the trench, when all pipe had been laid, as it worked its way back to shore.[G33]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

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37. *p.* Worcester Sewage Works. By P. Lamb. Pp. 67-68.
38. *p.* Some Chemical and Bacteriological Properties of Trade Wastes Containing Chromates. By H. E. Monk. Pp. 69-71.
39. *p.* Cheltenham's Remodelled Sewage Disposal Works. By G. G. Marsland. Pp. 71-72.
40. *p.* Treatment of Chromium Plating Wastes. By J. H. Spencer. Pp. 83-85.

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41. *p.* Distribution of Rainfall Within a Limited Area. By W. H. Elgar. Pp. 93-96.

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19. Before You Build an Incinerator. By H. W. Taylor. Pp. 55-56.

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31. Sludge Filtration: Laboratory Control. By L. W. van Kleeck. Pp. 310-313.
32. Bettering Sewage Treatment at New Britain, Conn. By J. R. Szymanski. Pp. 315-319.
33. *c.* Laying Subaqueous Steel Outfall Sewer by Three Men. By E. P. Eckhardt. Pp. 322-323.

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42. Some Operating Observations at Grand Forks, N. D. By K. W. Riley. P. 393.
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33. Incinerator Installed in an Old Boiler House. By W. L. Dunn. Pp. 17-18.
34. Minneapolis and St. Paul Sewer Rentals. By F. P. Bruce and L. N. Thompson. Pp. 28-29.
35. *n.* Reducing Explosion Hazards in Boston Manholes. Pp. 29-30.
36. What to Do When the Trickling Filter Ponds. P. 40.

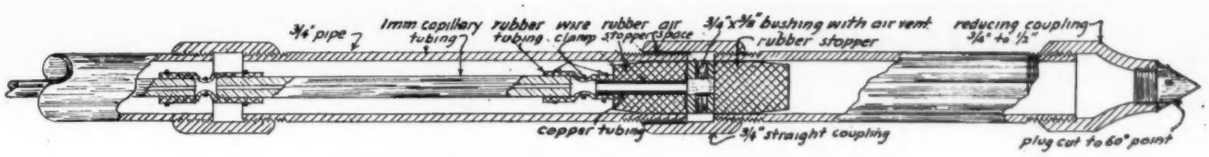


Fig. 2. Detail of the sampling tube used for collecting gases.

Gas Sampling Device for Sanitary Land-Fill Investigation

By LLOYD R. SETTER, Ph.D.
Asst. Professor of Sanitary Chemistry and Biology, New York University

A METHOD of garbage-refuse disposal practiced by the New York City Department of Sanitation consists of compacting the mixed garbage and refuse in a layer 10 to 15 feet deep, the surface of which is sealed with two feet depth of soil obtained near the filling operations. There are two 12 to 18-foot levels superimposed on each other in certain fills.

In planning a program of investigating the various public health and engineering aspects of such land-fill operations, the composition of gas present or evolved during the aging of the fill was considered of importance for the proper interpretation of the process. Singly or with other data, the composition of fill gas would give information relative to the importance of hazards due to spontaneous combustion, explosions, fire and odor nuisance; the beneficial or detrimental environmental effect on various stages of fly, rat and other insect and rodent life; and the kind of microbiological activity and rates of decomposition during the stages of fermentation, putrefaction and decay for the purpose of controlling or accelerating the process.

The gases as collected are conveniently analyzed for carbon dioxide, oxygen, illuminants, carbon monoxide, hydrogen, methane and nitrogen in a portable gas apparatus as illustrated by the Burrell apparatus in Figure. 1.

The problem of greatest concern in this study was the perfection of a suitable sampling device capable of collecting gas samples at various depths without contamination with gas from the atmosphere or from different strata down to a maximum depth of 25 feet.

A simple and inexpensive construction of the sampling tube was particularly desirable in view of the fact that occasionally the device might be wedged between rock, stones, sinks or other objects, and result in the loss of the sampling tube. At the same time, the tube had to be sufficiently rigid to withstand the force of a 4½-pound mallet while pounding it down to the desired depth, yet flexible enough to be diverted around some obstacles. The special copper alloy tube, 3 feet long, used in the Manchester, England, investigation (1) was considered unsatisfactory due to the large internal diameter and short length.

The sampling device selected consists of a metal housing made of ¾-inch galvanized pipe in 3 foot sections provided with a drive point and driving end. The housing carries ordinary glass capillary tubing 8 mm. x 1 mm. I.D. in 6 to 10-inch sections coupled with rubber tubing having a wire ring constriction as shown in sketch (Fig. 2). If the capillary tubing is supplied in longer sections, occasional shattering of glass occurs. The constricted tubing furnishes a rubber cushion between the glass ends.

A short length of copper tubing through a one hole rubber stopper is flanged on the lower side and connects to the capillary tubing with rubber tubing. The stopper is hermetically sealed into the bottom section of the pipe housing. The capillary tubing is of sufficient length to extend 3 to 5 inches beyond the housing end for ease in adding another section or connecting to the gas apparatus.

The drive point consists of a ¾ x 8-inch nipple, a ¾ x ½-inch coupling, a ½ x ¼-inch bushing and a ¼-inch plug. The fittings after assembly were turned down on an emery wheel to a point. The opposite end of the driving point nipple is closed with a solid rubber stopper supported from below on a doweling pin. Connection of the driving point to the first section of pipe housing is made by a coupling having four equidistant longitudinal grooves made slightly deeper than the coupling threads with a hacksaw. The two rubber stoppers were held in a rigid position by inserting a bushing between them consisting of a machine bolt nut having a ⅛-inch port hole bored perpendicular to the threaded hole.

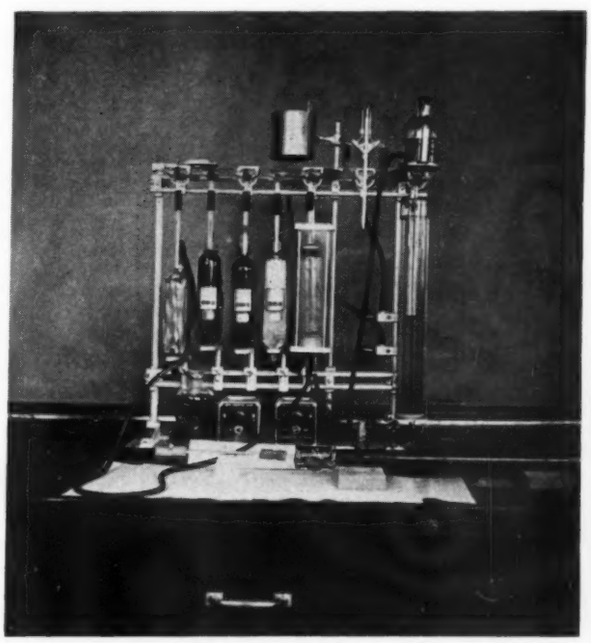


Fig. 1. Apparatus used for analysis.

Gas from without passes downward through the grooves of the coupling, thence horizontally via the port holes of bolt nut, to the threaded hole and then vertically up through the capillary glass tubing to a gas apparatus.

A 10 to 12-inch nipple with wrought iron cap and coupling serve as a driving end to protect the pipe threading and protruding capillary glass tube (temporarily capped with a medicine dropper nipple). Upon sinking the first section with a mallet, the driving end is removed with pipe wrenches and the capillary tubing is connected directly to the gas analysis apparatus. The 100 ml. gas buret is slowly filled by means of the hydrostatic head available and the sample is analyzed for CO_2 and oxygen. A second 100 ml. sample is then obtained and, if the first two analyses reasonably check the first test, a more complete analysis is made. The capillary lead to the gas apparatus is disconnected and quickly capped at a point such that after adding another section of pipe housing, the capped end protrudes from the pipe 3 to 5 inches. The driving end is now assembled and the pipe lowered to the next level. The sampler is raised with a 6 ft. lever arm and a home made pipe puller wrench.

Since on lowering the pipe, the pipe hole is considerably enlarged at the surface, a thick mud seal followed by a thin mud seal surrounding the pipe impedes transference of gases between fill and atmosphere.

Depending on the type of fill and obstacles encountered, the pipe and fittings suffer fatigue and must be replaced. Replacements after driving the sampler 600 feet an average depth of 10 ft. amounts to 15 couplings and 40 feet of pipe.

Typical results obtained are presented in Table 1. Sample No. 1 was taken from a soil land-fill made when landscaping the grounds surrounding the New York University Sanitary Engineering Laboratory. Samples two to four inclusive, are samples of gas from garbage-refuse land-fill.

TABLE I

Sample No.	*Depth (ft.)*	CO_2	O_2	CH_4	H_2	N_2
1	2	11.9	3.1	—	—	—
2	2	34.5	0.0	0.0	0.0	65.5
3a	2	30.4	0.0	7.4	0.0	62.2
3b	4	32.0	0.0	9.1	0.0	58.9
3c	10	39.6	0.0	8.2	0.3	51.7
4	6	16.0	1.6	2.4	0.0	80.0

Bibliography.—1. Jones, Bertram B., and Owen, Frederick. Some notes on the Scientific Aspects of Controlled Tipping. 1933 Manchester, England Report, Henry Blacklock and Co.

Acknowledgment. — The analyses reported were made by the Chemists of the Land-Fill Survey Project, Works Progress Administration.

Appreciation for the courtesy of furnishing illustrative data is given to the Works Progress Administration and the New York City Department of Sanitation.

Sewage Disposal and Garbage Reduction in Indianapolis

THE annual report for 1938 of the Board of Public Works of Indianapolis, Ind., covering the operation of the sewage treatment and garbage reduction plants, has been issued by Don E. Bloodgood, superintendent. Sewage is treated by the activated sludge method; garbage is by reduction, with sale of various by-products.

Sewage Data

An effort has been made to keep an up-to-date record of the number of air conditioning units and the quantity of water discharged by them. There were 186 such

units in 1937 and 287 in 1938. The amount of water discharged to the sewers from these increased from 526,145 gallons per hour in 1937 to 617,437 gallons in 1938, the discharge therefore being not in proportion to the increase in new units. The average flow of sewage was 53.07 mgad., varying from 43.24 mgad in October to 63.28 in July.

Plant changes included improvements to the mechanical removal apparatus at the West St. grit chamber, whereby operation is now for only a few minutes each 4 hours, greatly reducing wear resulting from previous continuous operation. Grit chambers have also been shortened. The washed grit is used for filling. Two new primary tanks are being added, and these are equipped with grease skimmers, the skimming being pumped to the digestion lagoons. A new sludge pumping station is being built. A change in the elevation of the head in the pump well resulted in a saving in power costs of $900.

From the sewage there were removed an average of 10.66 pounds of coarse screenings per million gallons; 14.34 pounds of skimmings; and 2.93 cubic feet of grit. The primary sludge resulting from treatment amounted to 779 pounds of dry solids per million gallons. Sewage flow amounted to 128 gallons per capita; other per capita figures are: Suspended solids, grams. 152.80; 5-day B.O.D., 0.213 pound; grease, 37.20 grams. Estimated population in 1938 was 410,000.

Average 5-day B.O.D. of raw sewage was 225 ppm., of clarified sewage 201 ppm., of plain aeration effluent 82 ppm., and of activated sludge effluent 22 ppm. The cost of operation amounted to $9.39 per million gallons, which was slightly higher than in 1937, due to salary and wage increases.

Garbage Reduction Data

The quantity of garbage treated at the reduction plant increased 12.1% over 1937, amounting to 27,444 tons. The reason for this increase was not definitely known, but was thought to indicate a further reduction in the amount of garbage used for feeding hogs. Market prices for by-products of reduction were materially lower than in 1937, so that even the increased quantity of by-products sold did not produce as much income as in the previous year. Receipts for 1938 were: Grease $51,949.91; fertilizer $11,484.25; feed $22,544.96; total income, $85,979.12. This gave an average income per ton of garbage of $3.13, whereas the cost of operating the plant per ton amounted to $3.74.

Grease sold amounted to 1,615,740 pounds; fertilizer sold, 3,113 tons; feed sold, 795.1 tons.

Rates of Public and Private Utilities

The U. S. Federal Power Commission has issued a report comparing the rates, taxes, and consumer savings of publicly and privately owned electric utilities. Rates of publicly owned facilities for residential, commercial and individual services are shown to be generally lower than those of privately owned systems. On the basis of totals for the country, publicly owned utilities paid 17.3 per cent and privately owned utilities paid 13.2 per cent of their gross revenues in the form of taxes and net cash contributions for the year 1936. In respect to savings to consumers or customers through rate changes, the Commission found that the private utilities were a little ahead of the public plants over the period from July 1, 1935, to December 31, 1937. The Commission stated in this respect that while the reductions are greater for privately owned plants, the average typical bills of publicly owned utilities were lower.—*Texas Municipalities.*

Cleaning and Straightening Waterways At Bridges

By ARTHUR BUERKLE
Surveyor, Tippecanoe County, Indiana

DURING my tenure of office, Tippecanoe County has lost two old iron bridges of 100-foot and 116-foot lengths due to clogged channel conditions. They were old spans and not suited for modern traffic both as to size and weight, having only 14-foot roadways with four and five ton limits, but they were on secondary roads and would be standing today had the channels been kept open. The first failure occurred in the fall of 1936, when a heavy rainfall flooded Moots Creek. Directly above the structure the channel had shifted to the west, and a sand and gravel bar some 600 feet long and 60 to 75 feet wide, overgrown with numerous poplar trees some 12 to 15 inches in diameter, had developed in the old channel. Unable to get through the structure readily, the flood flow caused a washout behind the east abutment. Although warning signs were posted, a truck was driven through and dropped down into this washout with a load of cattle.

Against my recommendations, a 16-foot roadway was placed, using the old abutments after one had been encased with new concrete. The levee was protected with a series of piles. A total of $9,158.85 was spent on this project with the channel still clogged by the island directly in front of the structure opening!

The other serious washout occurred in July, 1938. One abutment of a bridge was washed out as a direct result of the approach shifting some 50 to 60 feet over a number of years. If state highway spcifications are necessary in the rebuilding of this 100-foot structure by use of the gasoline tax funds (all we have in our budget for this year), my estimate of the cost of replacement, after cutting the span to 84-foot length, is $12,500. This possibly can be cut to between $10,000 and $11,000 if a roadway of 16 feet can be specified without state approval.

Equipment Needed

There are structures in other counties, as well as in Tippecanoe, which may go out the very next time "old man river" goes on a "bender." It would be money well spent to add a ⅜- or ½-yard dragline to the county highway equipment to use in remedying all of these clogged channels at once. The cost of replacement in either of the above mentioned cases would pay for a new machine of this size. When not being used for this service, it could be used for other purposes, such as dipping and loading gravel, digging and cleaning road ditches. It also may be used on clean-out work on some of the county court ditches, in which case the county would receive compensation the same as a private contractor. The list price of a dragline with a 30-foot boom, 14-inch shoes, 63 H.P. engine, equipped with a ½-yard bucket is $6,535. A special built, easy loading trailer, meeting state highway specifications, equipped with eight 32″ by 6″, 10 ply tires, lists at $960. A ½-yard shovel attachment for dragline complete costs $1,050. The ½-yard hoe attachment costs $850. This makes a total cost of $9,395 which, under competitive bidding, would likely be reduced. The gasoline consumption for such a machine having six cylinders with 3½″ bore and 4¾″ stroke for heavy duty is 3.7 gallons per hour, and the yardage output for an eight-hour day for dragline duty is 960 cubic yards and for the shovel is 500 cubic yards.—From a paper at the 1939 Purdue Road School.

Results of Frost Action on Experimental Road

A DETAILED account of experiments on a stretch of concrete road laid in a district particularly susceptible to frost action, on means of preventing frost damage is given by K. Keil in *Strassenbau.* Low embankments, construction at ground level, and shallow excavations alternated along this experimental stretch of road.

One roadway was constructed on foundations of the ordinary type consisting either of the natural soil, of similar soil mixed with gravel or quarry waste, or of gravel, but without any protective course; all the joints in the concrete surfacing were dowelled. The other roadway, which was the more heavily shaded of the two, was divided into several subsections. On certain of these, neither dowels nor a protective course were provided, while elsewhere protective courses of coarse sandy gravel or fresh granite quarry waste (½ in. to 2½ in.) were provided to varying depths (6 in., 12 in., 18 in., and 24 in.) and to a width of 30 ft., that of the carriageway being 24 ft. 6 in. On one subsection 264 ft. long, the natural soil was excavated to a depth of 32 in., the formation was covered with waterproof fabric impregnated with bitumen, and the excavated soil was replaced without any further protection. Pipe drains were provided throughout under the outer marginal strips, and transverse channels 4 in. wide and 2 in. deep were cut in the soil at the bottom of the various excavations.

The surfacing consisted throughout of concrete reinforced with steel wire mesh; the thickness was 8 in. except on one subsection, where it was increased to 10 in. The surfacing of most subsections consisted of three slabs 33, 43, and 56 ft. long.

Samples of soil taken at intervals of 80 to 130 ft. along the central strip were subjected to chemical analysis, mechanical analysis, and permeability and plasticity tests before, during and after construction; other tests included (a) regular observations of groundwater level, taken weekly at the sampling points; (b) determinations of the moisture content of the soil; (c) observations of capillary rise by Beskow's method; (d) temperature observations, taken thrice daily, and including atmospheric and surface temperatures, and soil temperatures observed at vertical intervals of 2 in. to a maximum depth of 56 in.; (e) measurements of the vertical movements of the slabs. Rivets 4 in. long with countersunk heads were placed in suitable sockets along the longitudinal axis of the slabs 12 in. from the transverse joint, and seven "fixed points" of the type recommended by Casagrande were provided. Measurements were taken every other day during the frost period, and subsequently once or twice weekly; observations at all points were carried out on the same day. The experimental stretch was kept clear of snow by means of snow-plows, the formation of ice being prevented by applications of salt solution.

The average mechanical analysis of the soil (70 samples) was as follows: colloids, 11 per cent.; clay (0.002 to 0.02 mm.), 42 per cent.; fine silt (0.02 to 0.05 mm), 37 per cent.; coarse silt (0.05 to 0.5 mm.), 5.5 per cent.; sand (0.5 to 2 mm.), 4.5 per cent. Maximum colloid content, 12 per cent. Other properties: capillary rise, 26.4 ft.; maximum and minimum permeability 3.35×10^{-4} and 2.35×10^{-7} respectively; maximum and minimum plastic index, 28.8 and 7.6; maximum and

minimum moisture content 29 and 12.3 per cent. (average 19.7 per cent.).

The conclusions reached are as follows: (1) With a given soil it is impossible to arrive in advance at a mathematical determination of the expected danger from frost which will enable suitable preventive measures to be taken, especially as each successive frost alters the conditions on which such a calculation would be based. (2) The main line of defense against frost is a protective course of gravel or ballast below the surfacing. (3) Dowelling of the transverse joints proved thoroughly successful in maintaining a plane surfacing, but should always be accompanied by the use of a protective course. (4) The required minimum thickness of a protective course on cohesive soil, assuming a frost of two months' duration and a frost penetration depth of 80 cm. (31 to 32 in.), is 45 cm. (17 to 18 in.). (5) In the absence of a protective course, the danger to a concrete surfacing is greater during the thaw than during the frost, due to the prolonged softening of the subgrade and the loss of firm support. Thickening the slab and the road base does not overcome deficiencies of the subsoil.—Adapted from *Road Abstracts*.

Speed Test Section Construction in German Motor Road

In the construction of the motorway between Berlin and Leipzig, the German Highways Authorities have included a section specially designed to permit record speed tests of motor vehicles. The section is built, like most of the road, on a foundation of rolled earth. Over this the roadway has been laid in four successive layers of concrete. A thin upper surface provides the necessary smoothness for high speed tests.

The record track provides a section 9.33 kilometres (5.797 miles) long in a perfectly straight line, the road having a total width of 32 metres (104.96 ft.) and a surfaced running width of 27 metres (88.56 ft.) At either end of the record track this width is reduced to the normal speedway width of 22 metres, and the central parkway which divides the speedway into two separate one-way roads is again provided.

The record track is built in three parallel strips of 9 metres (29.32 ft.) width, separated by expansion joints. These three strips are given a perfectly flat surface, but to provide drainage they are very slightly banked to 0.75 per cent.

Each of the three strips which makes up the road is divided in two sections by a longitudinal joint, formed by merely painting the edge of the concrete after hardening, and then casting the next section up against the first. This division is mainly intended to facilitate repair work.

All the joints of the roadway are designed on the tongue and groove principle, so that adjoining sections cannot sink at different rates and leave ridges on the road surface. Joints between strips, and others placed crosswise across the road every 10 metres on the two lateral strips and every 20 metres on the central one, provide an expansion space 18 mm. (0.70 in.) wide. This space is filled with bitumen, poured into the joint after setting of the concrete.

In laying the concrete, the first two layers, each 9 cm. (3.54 in.) thick, were cast without special precautions, and tamped by compressed air tamper. These two layers have no reinforcement, except at the joints, where 14 mm. dia. (0.55 in.) anchor bars, 5 ft. long, are provided in the second layer.

A general reinforcing of reticulated structural steel

rod mats is laid on the surface of the second layer after setting, and the third layer cast over this. The third layer is 5 cm. (1.96 in.) thick, and both the mix and the tamping are the same as in the first two layers. The only difference is that 14 kilogrammes of lampblack per cubic metre of concrete was added to the mix used for the laying of the centre strip, and for the gutters at the edges of the road. The purpose of this addition was merely to provide a visible marking of the strips.

The surface layer of concrete was mixed with slightly more cement than the first three layers, having 350 kilogrammes of cement per cubic metre instead of 250 kilogrammes. For the mix used on the centre strip and on the gutters, lampblack was added in the same proportion as in the layer directly under the surface.

This surface layer, 2 cm. (0.78 in.) thick, was vibrated with beam vibrators and then rolled over with a light wood roller to even off the extruded moisture and cement on the surface. Final finish was obtained by drawing a tightly stretched strip of sailcloth over the surface of the road, the ends of the cloth being held at the edges of the strip of concrete. This removed all excess moisture from the surface and insured an absolutely smooth surface after setting. Once setting was completed, specifications required that there should not be a variation in the surface of more than 3 mm. (0.11 in.) in any straight line on the road surface, of 4 metres (13.12 ft.) length.

Five New Water Projects by WPA in Washington

Plans for new WPA water system construction projects at Auburn, Tacoma, Blaine, Carrolls in Cowlitz county, and in Panorama Heights, just south of Seattle have been prepared in collaboration with the WPA. Construction on all of these projects will begin early in September.

Improvements will be made on the Auburn water sheds by clearing 15 acres, cleaning out 1,500 feet of spillways, and building more than a mile of woven wire and barbed wire fence. More than 2,000 feet of iron pipe will replace wood stave pipe through this project. The work will require until early in December to complete and will cost the WPA $10,523 and the city $5,788.

The area of Panorama Heights bounded by 100th and 104th south, and First and Third Avenues, South, near Seattle, will get new water lines through a $4,512 allocation from WPA and $2,690 from Water District No. 20.

About 360 feet of water main will be laid in Tacoma along East 84th Street from East "C" to East "D" streets, and more than 2,600 feet on East "D" from East 84th to East 90th. This project will provide water to 500 residents who heretofore have had to use water from wells. WPA funds of $6,353 will be combined with $3,511 from the Tacoma water division. Four months will be required for the job.

Blaine will get 7,215 feet of new mains, ranging from 4 to 12 inches in diameter, 3,400 feet of distribution pipe, and 1,000 feet of pipe flume, all installed by WPA with $13,705 Federal funds and $8,682 from the city.

At Carrolls, WPA will install 3,200 feet of 4-inch wood-stave pipe, construct a reservoir dam, make a 150-foot trestle, clear two acres of the area, and build a new chlorination house. Workers will also install fittings and the chlorinator. The present water system has been condemned by the state health department. This project will take until late in November to complete, and will require $7,925 from WPA and $2,411 from the local school district.

One-way snow plow mounted on a truck clearing light snow, which is thrown back to avoid formation of banks. This illustration shows typical action of the one-way plow

Equipment for Snow Removal and Ice Control

PREPAREDNESS is especially important in snow removal and ice control because snow and ice come without much warning—often with none—creating traffic conditions that must be cared for promptly. To safeguard traffic and keep it moving, advance planning, adequate equipment and good organization are necessary.

Maintenance personnel and maintenance equipment usually form the nucleus of the snow fighting organization. Personnel will usually consist of the regular employees which, when necessary, can usually be supplemented quite quickly from the unemployed. Except for hired trucks, this is not the case with equipment and materials; and these cannot be improvised. A shortage of plows in rural sections, of loading and hauling equipment in cities, or of cinders and chemicals for ice control, seriously handicaps the work and may increase the cost of doing it even beyond the cost of the needed equipment.

Motive Power.—Trucks are used principally with snow plows, tractors being employed in the heaviest drifts, for supplementing the trucks, and for sidewalk plowing. City or county-owned trucks can be, and usually are, supplemented by hired trucks. It is the common practice to arrange for these well in advance of the snow season, and in the fall equip them with attachments for mounting plows. Tractors are not so often rented.

For plowing sidewalks, special equipment must generally be used because sidewalks are too narrow to permit the use of standard width equipment. A number of sidewalk plows are manufactured, but adequate motive equipment for them limited. One company manufactures, especially for sidewalk plowing, a narrow gauge tractor. This can be used to supplement regular plows after the sidewalks have been cleared with it.

Plowing the snow to the sides or to the center of city streets and leaving it there is unsatisfactory, as it results in a constricted traffic way and interferes with shopping and parking. Complete removal of the snow is desirable. Special snow loaders are available, which during the remainder of the year can be used for material loading and handling. It is worthy of note that few, if any, cities that have initiated complete removal of snow from their streets and plowing of sidewalks have discontinued either practice. Both of these services are greatly appreciated by the taxpayers. Both are accomplished most economically and most satisfactorily by proper equipment.

Plows.—There are four principal types of snow plows, each designed to do a certain job well. For city streets, the reversible blade plow is most used. This does not "throw" the snow, but rolls or pushes it into a furrow or bank. This is relatively low-speed equipment; it can be used with a truck or tractor, either light or heavy.

The one-way plow is a blade plow that is operated at 20 to 40 miles an hour, throwing the snow clear of

THE SURE, LOW COST WAY OF REMOVING HIGHWAY ICE AND SNOW

INTERNATIONAL'S ROCK SALT

Left—A safe street is East Avenue, Rochester, N. Y. Small amounts of Rock Salt without abrasives, were used according to proven methods, and the street was then plowed. No packed snow or ice remains. The street is bare—and *Safe!*

Above—A side street in Rochester, N. Y., photographed from its intersection with East Avenue (see picture at left). Straight Rock Salt was used at the intersection, and the street is bare and safe. Beyond the point where Rock Salt was used, the hard-packed snow — even on this side street — defied the plow.

STREET and road officials now know that scattering grits and abrasives over an icy surface is not enough to satisfy the increasing public demand for *safer* streets and highways in winter. The public knows as well as public officials, that ice and snow are dangerous to traffic so long as they remain on a pavement.

The International Salt Engineering Department has worked for many years in close co-operation with street and road engineers, superintendents and maintenance men. This work has developed new methods for using Rock Salt to clear ice and snow from pavements—methods that are not only practical but also highly economical.

International places the benefit of all its long experience at the disposal of any state road engineer or city street official, without cost or obligation. Ask for a consultation. Find out what others are doing, in practically every state. Discover why some northern cities have prosperous business in the winter, while their neighbors suffer from roads and streets made dangerous by hard-packed snow and ice. Discover how economical it is to make highways and streets really safe by clearing them with new Rock Salt methods. International's Retsof and Detroit brands of Rock Salt are equally economical. Write for a copy of an attractive folder showing how pavements are made really safe.

POUNDS OF ICE MELTED PER POUND OF CHEMICAL
Maintenance Committee, Highway Research Board Vol. 13

Temperature Deg. F.	Sodium Chloride (Salt)	77-80 percent Flake Calcium Chloride	ADVANTAGES OF SODIUM CHLORIDE AS CALCULATED BY INTERNATIONAL SALT COMPANY, INC.
30°	46.3 lbs. of ice	31.1 lbs. of ice	48.9%
25°	14.4 lbs. of ice	10.4 lbs. of ice	38.4%
20°	8.6 lbs. of ice	6.8 lbs. of ice	26.4%
15°	6.3 lbs. of ice	5.5 lbs. of ice	14.5%
10°	4.9 lbs. of ice	4.8 lbs. of ice	2.0%
5°	4.1 lbs. of ice	4.4 lbs. of ice	— 6.8%
0°	3.7 lbs. of ice	4.0 lbs. of ice	— 7.5%
—6.5°	3.2 lbs. of ice	3.7 lbs. of ice	—13.5%

WHY INTERNATIONAL'S ROCK SALT IS SO ECONOMICAL WITH THIS METHOD

Because of its great melting power, Rock Salt is most economical for use in treating stock piles of abrasives to keep them from freezing, and in treating abrasives so that they will be imbedded in ice. For the same reason, Rock Salt used alone is the most economical melting agent to *remove* ice and hard-packed snow. A little does much. In addition, this method saves: cost of abrasives, cost of treating, storing, reloading and applying them; the cost of removing them from roads and streets, sewers and basins later; damage to pavements by abrasives; and, since proper use of straight Rock Salt corrects all effects of storms with one treatment, saves the cost of treatments with abrasives several times a day for several days. No wonder public officials say:

"It costs less to keep pavements bare."

INTERNATIONAL SALT COMPANY, Inc.
SCRANTON, PA. NEW YORK, N. Y.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 62 to 65

the road. It is practically always truck-mounted; mounted on the heavier types of trucks, the one-way plow will handle snow depths up to about 12 inches. The design of the blade should be such that the snow is not thrown into the truck radiator or windshield, but aside and off the road. General practice is to start one-way plows shortly after the beginning of a storm, and to continue work until the storm has stopped and all roads have been opened. Since these fast plows cannot operate in deep snow, there must be a sufficient fleet of them available to cover the entire road net at frequent intervals.

Plows for Heavy Going

For heavy going, in drifts, the V plow is most efficient. For heavy drifts, the V plow should be mounted on a heavy truck. The four-wheel driven and tractor trucks are excellent for this heavier plowing. For lighter snows, smaller V plows are mounted on 1-ton or 1½-ton trucks. The V plow is also a fast plowing unit, and on the more powerful trucks is adapted to opening drifted cuts, widening and plowing drifted rural roads.

Wings are often attached to trucks carrying snow plows, these being used to bevel off the tops of the side banks of snow and, where the depth is not great, to widen the cut made by the plow.

High-speed plowing requires quick and sure control of the plow, which is best attained by the use of hydraulic control equipment. Such controls are available for all types of plows and for wings.

For extremely deep and heavy snow, the rotary plow, mounted on a tractor or heavy truck, is best. This throws the snow away from the highway and therefore is particularly adapted to widening deep cuts.

The fields for use of all of these plows overlap, and it is possible to use each in a wide variety of service. The V plow, for instance, is effective for plowing the opening track in city streets, though ordinarily it is most useful in rural work. An adequate supply of equipment permits each unit to be employed on the work that it is best designed for, and also provides a reserve for emergencies and for breakdowns. First cost of snow plows is not great. The costlier motive equipment can be rented, if not enough is available from maintenance and construction equipment.

What the basic needs for equipment are, as to numbers, is a matter on which few engineers are in agreement. In a state, where really severe snows rarely affect more than a portion of the area, extra equipment can be drawn from one section to aid another. In a county or a city, this is not possible. Enough equipment must be on hand to handle even severe storms and for each five pieces of equipment there should be one in reserve.

Ice Control.—In ice control, properly treated cinders or sand must be available at needed places. Trucks equipped with spreaders will be needed to distribute the grit. Locations for piles of grit and the placing of the grit there requires advance planning; also the treatment of the grit with calcium chloride or salt, which greatly increases its effectiveness in preventing skidding, and also reduces the amount of grit needed by 15% to 40%. About 100 pounds of chemical should be provided per cubic yard of sand or cinder, and about 1½ to 2 pounds of the treated grit should be provided per square yard of surface to be treated. Application may be by hand for very small areas, but on hills, streets, curves and similar places, the use of sand or grit spreaders is economical, both in saving material (15% to 40% being saved by machine spreading) and in cost of application.

Suggestions for Designers of Sewage Plants From Operators of Them

THE following suggestions from sewage plant operators to the engineers who design such plants have been prepared by the Division of Sanitary Engineering of the Illinois Department of Public Health, largely from comments it has received from operators and discussions at their sectional meetings.

General:

1. Location of plant unnecessarily close to residential property puts the operator under a severe permanent handicap. More attention to choice of site is urged.
2. Diversion chambers on large combined sewers should not permit entrance of playing children. Tragic accident resulted from this at one place.
3. Small, gas-engine driven portable pump desirable for miscellaneous service.
4. Venturi meters located in separate, *drained* vaults outside of building best. Should not be located in wet well.
5. Steel weir plates, bolts, valve stems, etc., just will not last around a sewage treatment plant.
6. A plentiful supply of good water under pressure is an essential to good sewage plant operation. Although this may occasionally be costly, it really is a necessity.

Screens and Shredders:

1. Bar spacing of manually cleaned screens to give 1½ inch clear opening considered best. Two inch openings too large and one inch openings too small.
2. Although opinions varied as to whether it is best to locate comminutors before or after grit removal, most operators favored comminution *after* grit removal.
3. Comminutor motors should be located well above high water elevations.

Grit Chambers:

1. Grit removal facilities desirable at *all* plants, regardless of type of sewer system.
2. Should be located ahead of pumps if at all possible.
3. Deep grit chambers intended to be manually cleaned are very unsatisfactory. Mechanical grit removal equipment desirable in all chambers more than 6 feet deep.
4. Sufficient usable space for removing and handling grit should be provided for in locating units.

Sewage pumping:

1. When long, narrow wet well is employed, the dry weather flow pump should be located at the end farthest from the inlet so that the bottom will scour and solids deposition will be minimized. Bottom should be sloped to suction pipes.
2. Manhole or other means of entry to wet well should be located outside of building. If opening *must* be indoors, tightly bolted and gasketed cover should be used.
3. Electrical control panels and switch boxes should not be located in deep pits where dampness exists.
4. Piston type check valves on sewage (or sludge) pump discharge lines definitely unsatisfactory. Flap or ball checks should always be specified.
5. Emergency overflow is highly desirable to prevent flooding of dry well and motors.

Primary Sedimentaion:

1. Special care should be taken to obtain smooth concrete on inside of Imhoff tank settling channels and in sludge hoppers of plain sedimentation tanks. Rough walls require frequent cleaning.
2. Channels carrying raw sewage (particularly at settling tank inlets) should be designed to minimize deposition of solids therein.
3. Mechanical skimming devices *always* needed at separate sedimentation tanks.
4. An overflow weir (adjustable) should *always* be provided at the effluent channel of primary tanks to insure against flooding during extreme flows.

Sludge Pumps and Piping:

1. Sludge pumps with suction lift have proven troublesome on primary and secondary tank sludge lines. Positive suction head on *all* sludge pumps is recommended.
2. Provision should be made for draining all infrequently used sludge piping.
3. Sludge sampling cocks should be non-splashing, sampling point should be close to sludge pipe to minimize waste and waste drain should be provided.
4. Cross or tee at bends in sludge (and gas) piping provides convenient cleanout in case of clogging.

Sludge Digestion Tanks:

1. Should never be located deep in ground where ground water level is high because of difficulty in heating.
2. Entrance to control chamber by side-entrance door is safer and generally more satisfactory than by manhole in roof.
3. Deep sink should be provided to receive waste from supernatant sampling pipes. This piping should never be less the 1½ inches in diameter.
4. When heating coil header is used, the header should be located in the control chamber—not inside digester.
5. Raw sludge feed pipes should discharge as far as possible from supernatant outlets, (according to O. P. Rator). If the discharge point is 15 to 20 feet from the supernatant outlets it should be all right, however.
6. Provision should be made for prevention of surface water collection in floating covers or else for drainage of such.
7. Convenient means for making digester temperature observations is highly desirable.
8. Leaded joints of cast-iron pipe heating coils eventually open up because of expansion and contraction. No difficulties reported with wrought iron pipe having threaded joints.

Gas Collection Facilities:

1. Arrangement and location of piping and appurtenances should be such that inspection and maintenance can be afforded without engaging a contortionist. (We heard of a gas meter installed backwards, which had to be read with a mirror.)
2. Special precaution should be taken to assure

plenty of slope and a permanent foundation for outside, underground gas lines, to prevent settling.

3. Gas meter should be protected by adequate drip traps and connecting piping should include unions to facilitate removal of meter. By-pass around meter is essential.

4. Rotary type gas meters best for large, uniform gas flows. Diaphragm type meters best for small, variable flows.

5. Waste gas burner should be located at least 50 feet from any other structure.

Sludge Drying Beds:

1. Provision should be made for protection against surface water wash on to sludge beds by drainage.

2. Truck tracks in sludge beds should be sufficiently wide to permit entrance of double-wheel trucks.

3. Entry to truck track should be at least 10′ wide.

Trickling Filters:

1. In some fashion, nearly all trickling filter plant operators have provided some sort of removable ¼ to ½ inch wire mesh screen to remove nozzle and orifice clogging objects from the settled sewage. Could not this be provided for in design?

2. Operators opine that *all* trickling filters should be designed so they can be flooded for fly control.

3. Least difficulty with "pooling" is reported where filter stone 1½ to 2½ inches in size is used.

Activated Sludge:

1. Return activated sludge wells should not be so large that sludge can become stale and septic therein.

2. Ports, channels and piping should be designed to minimize variation in aeration tank water surface elevation. Variations of one inch between low and high flows not harmful.

3. Variable discharge return sludge pumps are regarded highly for their flexibility.

Service Building and Laboratory:

1. Laboratory water faucets should be at least 15 inches above bottom of sink to permit washing of glassware. Regular laboratory sink (with gooseneck faucets) or deep slop sink is satisfactory.

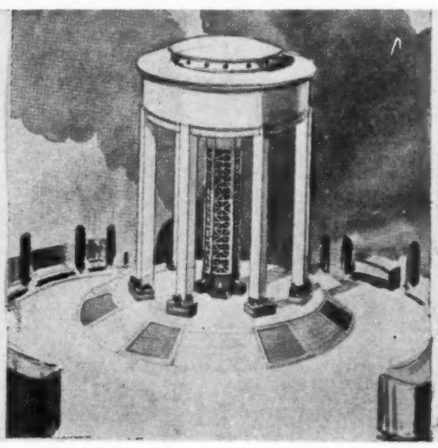
2. Even in small sewage treatment plants, a privy at the rear of the grounds appears slightly inconsistent. After all, a water-flush toilet doesn't cost much.

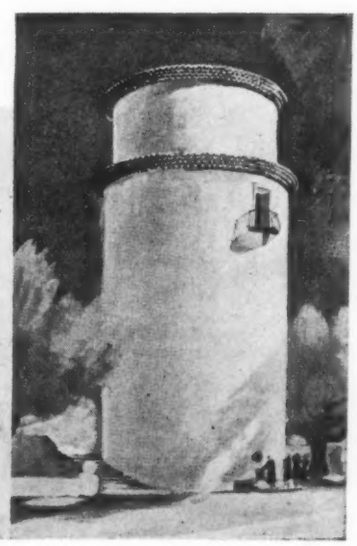
3. Several operators of large plants indicated a desire for closet space for storage of records, etc.

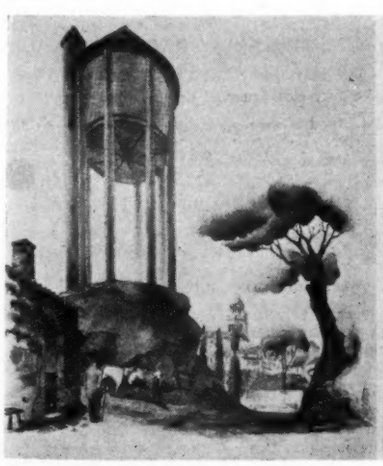
4. If screens or comminutors are housed in service building, they should be partitioned off, the screen room provided with an outside door and given good ventilation.

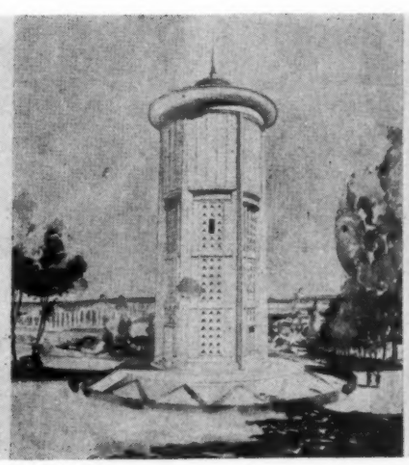
French Designed Elevated Water Tanks

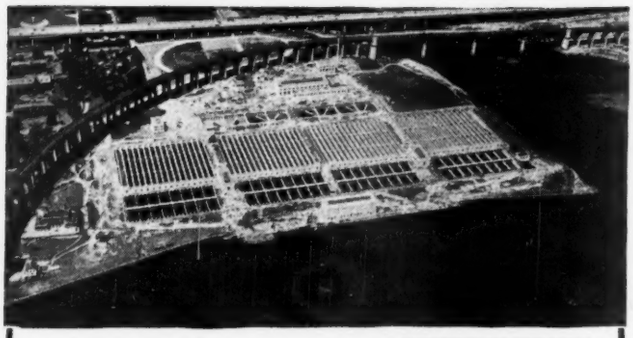
The winners of six prizes for water tank designs for small communities, offered by the Societe des Agriculteurs de France, for which 150 architects competed.









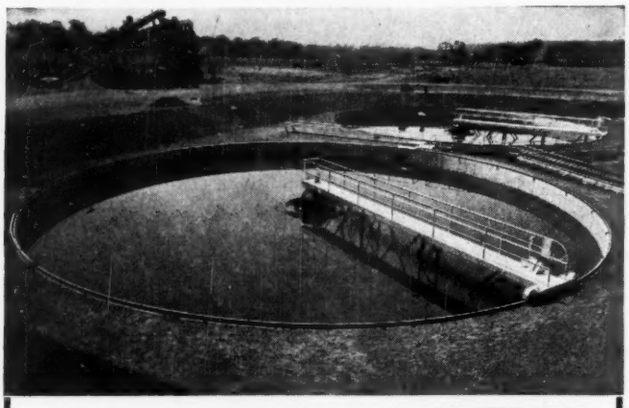


32 Final Settling Tanks equipped with STRAIGHTLINE Collectors, Ward's Island Sewage Treatment Plant, New York City. Fuller & McClinlock, Consulting Engineers.

STRAIGHTLINE COLLECTORS PROVE OUTSTANDING ECONOMY AND RELIABILITY

STRAIGHTLINE operation is of proved reliability. Link-Belt units have been in operation for over a decade and many installations are now in service in all parts of the country. They range in size from the smaller type plant as at Tappahannock, Va., with a capacity of 80,000 G.P.D., to larger installations such as Ward's Island, N. Y., with a capacity of 180,000,000 G.P.D., and Southwest Plant, Sanitary District of Chicago with a maximum capacity of 600,000,000 G.P.D.

Many features of the Link-Belt STRAIGHTLINE Collector are patented. Send for Book No. 1742.

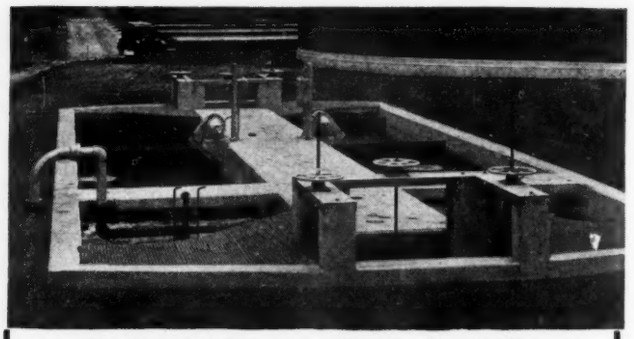


City of Dayton, Ohio, 4 final tanks equipped with CIRCULINE Collectors. M. D. Tatlock, Consulting Engineer and Superintendent.

CIRCULINE COLLECTOR WITH STRAIGHTLINE EFFICIENCY

The Link-Belt CIRCULINE Collector provides round tanks with the same important features which have made the STRAIGHTLINE Collector the acknowledged standard for rectangular tanks.

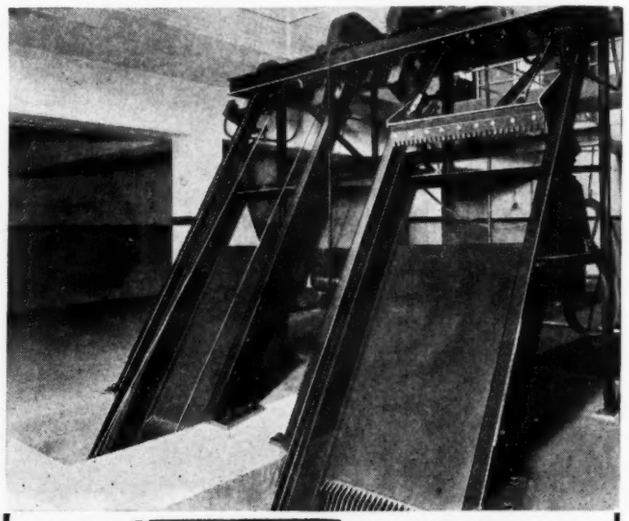
A CIRCULINE equipped tank is provided with a revolving bridge carrying a sludge plow and a STRAIGHTLINE conveyor which positively delivers the settled solids into an annular covered sludge trough from which they are withdrawn. The entire floor of the tank is cleaned of settled solids during each revolution of the bridge, thereby permitting extremely slow movement of the bridge and conveyor, which assures minimum disturbance of settling and of the settled solids. Send for Book No. 1642.



Link-Belt Horizontal Mixer at the Danville, Ill., chemical treatment plant. Greeley & Hansen, Consulting Engineers.

EFFICIENT FLOCCULATION

Link-Belt mixers of the vertical or horizontal type have proved their value in reducing chemical costs and promoting efficient flocculation.



Link-Belt STRAIGHTLINE Mechanically Cleaned Bar Screens at Sewage Pumping Station, Lackawanna, N. Y. Nussbaumer & Clark, Inc., Consulting Engineers.

A BAR SCREEN THAT CANNOT JAM

The STRAIGHTLINE Mechanically-Cleaned Bar Screen is the modern method of removing large suspended solids and debris from incoming sewage at both large and small plants.

All of our experience with sewage screening work, since the installation of the first Link-Belt mechanical screen in 1915, is built into the design of this unit. Its rugged, simple construction and special provisions for the avoidance of jamming assure dependable, uninterrupted operation under the most extreme conditions of service. Send for Book No. 1587.

LINK-BELT COMPANY 7844

Philadelphia Chicago Los Angeles Indianapolis
Cleveland Atlanta Toronto Offices in Principal Cities

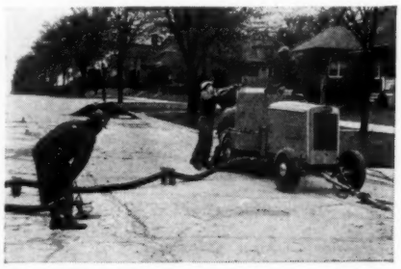
LINK-BELT
SEWAGE TREATMENT AND WATER PURIFICATION PLANT
EQUIPMENT

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 62 to 65

Keeping Up With New Equipment

The Mud-Jack and the Mud-Jack Method

Koehring has redesigned the mud-jack, and the new model is shown in the accompanying illustration. A new booklet about this handy and money-saving equipment is also available. This gives complete information, with line drawings, sketches and photographs of the proper procedure for the following types of work: Raising depressed highway slabs; super-elevating concrete highway curves; elevating pavements before widening; raising walk and gutter slabs; raising pavements and bridge abutments; correcting trench settlement; raising tracks; compacting fill; and doing many other similar jobs. Sent on request. Koehring Co., Milwaukee, Wisc.



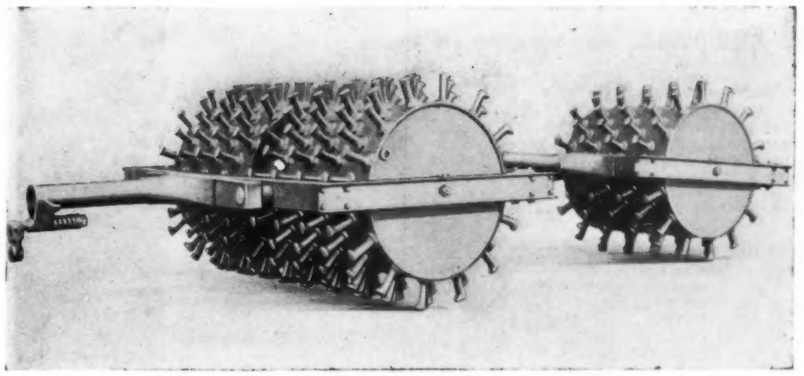
This shows the redesigned Mud-Jack at work

Removing Excess Filler from Brick

A spray solution to facilitate the removal of excess tar from new brick pavements has just been announced by The Dow Chemical Company, Midland, Michigan. This solution consists of 100 pounds of calcium chloride and 40 gallons of water with 6 pounds of starch. Spraying the bricks with this solution after they have been laid in place prevents the tar filler from sticking to the brick and allows the excess tar to be easily removed from the surface of the pavement.

The tar is poured at a temperature ranging from 350 to 400 degrees Fahrenheit and allowed to harden. The excess tar is then easily removed from the surface by means of a scraper. When bricks have been treated with calcium chloride solution the tar does not stick to them, and is peeled up in long narrow ribbons by the scraper and may be used again.

The photograph illustrates removal of tar from a Cedar Rapids, Iowa brick pavement which was first sprayed with the calcium chloride solution.



New Galion tooth-cleaning sheepsfoot roller

Sheepsfoot Roller with Tooth Cleaner

This new roller, which is said to be highly efficient for tamping earth fills, has a hitch that is specially designed for easy attachment to a tractor or to additional rolls and also a device for cleaning the teeth by passing them at each revolution through a set of teeth placed on the cross-frame member. The roll, without the teeth, is 40 ins. in diameter; the teeth are 7 ins. long; from 64 to 120 feet can be furnished in a 48-inch wide roller. With 112 feet, the single unit weighs 3140 pounds empty and 4990 pounds with water ballast; double units weigh slightly more than twice as much. Sheepsfoot rollers have a wide usage in highway construction, as well as in all compaction work, as on dams, embankments, etc. Galion Iron Works & Mfg. Co., Galion, O.

Goodyear "Hi-Miler" Tire

Two New Truck Tires by Goodyear

Designed especially for giving truck operators a greater tire mileage, Goodyear Tire & Rubber Co. has announced a new All-Weather tread to provide traction under all conditions, and a Hi-Miler for long mileage. The latter is illustrated herewith.

Cleaning filler from brick pavement in Cedar Rapids

Readers' Service Department

These helpful booklets are FREE. Write to the firm whose name is given, mentioning PUBLIC WORKS, or to this magazine.

Construction Materials and Equipment

Air Compressor from Ford Parts

5. How you can convert an ordinary Ford model A or B motor into an air compressor for operating jackhammers, paving breakers, clay spaders, tampers, paint sprays, etc., is explained in a new bulletin just issued by Gordon Smith & Co., Desk G, 516—10th St., Bowling Green, Ky.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subject suggested by title.

36. "Wyandotte Calcium Chloride and its use in Portland Cement Concrete," a booklet covering the subject of curing concrete pavements, structures, etc., giving complete specifications for surface and integral curing. Published by the Michigan Alkali Co., 60 East 42d St., New York, N. Y.

Concrete Mixers

44. Catalog and prices of Concrete Mixers, both Tilting and Non-Tilt types, from 3½S to 56S sizes. The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Dirt Moving Efficiency

65. "Dirt Moving," is a new 32 page booklet illustrating the use of Trac Tractors as a source of money-making power for bulldozers, bullgraders, wheel scrapers, fresnos, graders, dump wagons, tampers, etc. 24 pages of action pictures, directions, etc. Sent promptly by International Harvester Co., 180 No. Michigan Ave., Chicago, Ill.

Drainage Products

70. Standard corrugated pipe, perforated pipe and MULTI PLATE pipe and arches—for culverts, sewers, subdrains, cattlepasses and other uses are described in a 48-page catalog entitled "ARMCO Drainage Products," issued by the Armco Culvert Mfrs. Association, Middletown, Ohio, and its associated member companies. Ask for Catalog No. 12.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Mud-Jack Method

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and street solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Paving Materials, Brick

116. Standard specifications for vitrified brick pavements and brick parking strips and gutters, as adopted by the American Society of Municipal Engineers. Also standard specifications for bituminous filled brick pavements adopted by the American Association of State Highway officials. If you contemplate using brick for paving, you should have a set. National Paving Brick Ass'n, Washington, D. C.

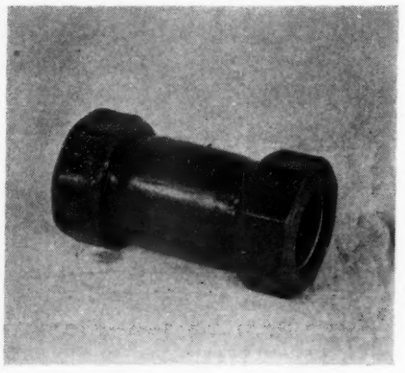
Pumps

121. New illustrated catalog and prices of Jaeger Sure Prime Pumps, 2" to 10" sizes, 7000 to 220,000 G.P.H. capacities,

(Continued on page 63)

Dresser Super Service Fittings

This is another aid for water works men. It will make tight joints on undersize or corroded pipe; no threading is required; plain-end pipe used; not necessary to line up pipe ends or to have the pipe the exact length. Where leaks are caused by settlement, expansion, contraction, frostheave, vibration, etc., this joint is designed to correct the conditions causing leakage. Made in regular and long couplings, 45 and 90 degree ells, and tees, sizes ¾-inch to 2-inch, inclusive. Full data from Dresser Mfg. Co., Bradford, Pa.



Dresser Small Coupling

Protection Against Corrosion of Metal

Feroleum is a non-oxidizing vehicle for protective coatings to prevent rust, rotting or corrosion. It is claimed that, because it is non-oxidizing, the film maintains itself and is actively protective and stable for a very long time. It is also claimed that paints with the feroleum (metal ester of polymerized oil) are equally effective when used on either clean or rusted surfaces. They can be used for protection against acid, alkali, fume, salt spray or weather.

A most interesting set of booklets and information can be obtained by writing Feroleum Products, 11 West 42nd St., New York, N. Y.

Double-Bar Tractor Mower

This mower has two cutting bars so that the machine can be operated on a congested divided highway, mowing the center parked area, and still always operate with traffic. It can also be used for other highway or airport mowing. Sickle bars are orthodox construction; both are raised or lowered by power controls in 2½ seconds. Engine is 6-cyl.; 4-speed transmission; 5-ft. bars; speed 3 to 45 mph. Toro Mfg. Co., Minneapolis, Minn. See also PUBLIC WORKS, June, 1939.

New Toro Double-bar mower

New Protractor Saves Time on Pipe Work

The Trumark protractor, made by Advance Sales Company of Los Angeles, Calif., gives immediate and accurate cut lines and layouts on any size of pipe, for torch cutting, sawing or shearing, without the use of templates. It eliminates the use of templates, also wrap-arounds and engineering computations, does away with guesswork and saves time and material. It can be used by anyone, in the field or the shop, without previous experience or layout training, to obtain accurate cut marks.

The protractor is placed on the pipe or any rectangular shape and is held in level position by a strong spring chain. The level is determined by a bubble indicator. Any desired angle for the cut is set on the 180 degree scale. The marking arm may then be moved completely around the pipe. The marking is done by a special chalk that will not blow off and is easy to follow. The protractor is rigid in marking position and scribes a true line. Construction is of cast aluminum alloy. Four models handle pipe up to 3", 6", 12" and 36" respectively. Data on request.

Why Use a Roller for Patching Pavements?

After spending good money to place patching material in holes in street or highway surfaces, there are three ways to finish the job, says the *Elbee Tatler* (Littleford Bros.). These are: 1. Let traffic roll it out. 2. Pat it lightly with a shovel. 3. Use a good roller.

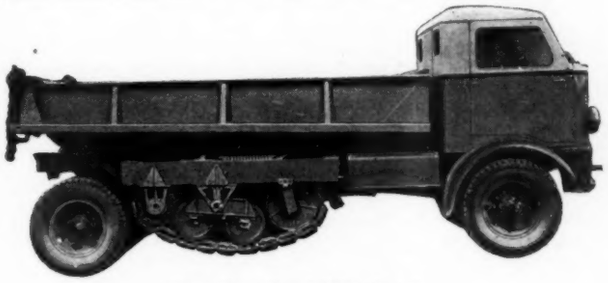
If the first method is used, you will undoubtedly get a rough job due to having a hump or a low spot on the road which, of course, is not desirable. If the patching gang simply gives this patch a loving little "pat" with the back of a shovel, the material still remains loosely compacted in the hole, and the next truck or automobile wheel will loosen it up. The third method is the correct and most economical way to do the patching work. It rolls the material compactly and smoothly. If there is no sub-grade failure and the material is put into the hole properly, the patch will then remain there for the rest of the life of the pavement.

Ferric Sulphate for Water and Sewage Coagulation

A small folder is available giving briefly the advantages of ferric sulphate, cold water soluble, for treating sewage and sewage sludge, industrial wastes and water. Further information regarding your specific problem will be sent on request. Tennessee Corp., Atlanta, Ga.

Linn Announces New Type of Haulage Unit

The Linn Manufacturing Corporation, Morris, New York, has announced a new typ of haulage unit, known as the Model C-5, which can be instantly converted from track to wheel operation, or vice versa, merely by throwing a control lever mounted at the driver's position.



New Linn Track-Wheel unit

The illustration shows the C-5 operating on dual pneumatic tired wheels, with seven inches of road clearance under the traction unit. In this position, the drive is on the front wheels; the traction unit idling, and merely revolving should it hit an obstruction. The load distribution is 50/50 on front and rear wheels, with a maximum speed of 35 M.P.H. When track operation is desired, the operator pushes the control lever and the rear wheels are raised hydraulically to allow nine inches of road clearance, or they can be allowed to trail or float behind the traction unit.

When the C-5 is operating on tracks, the load distribution is 75% on the tracks and 25% on the front wheels, with the drive on the tracks and front wheels simultaneously. Maximum speeds, loaded, on tracks is 12 M.P.H.

The hydraulic jackknife lever unit which raises and lowers the rear wheels locks off center so that when operating on wheels the load is carried on the rear axle only, never on the cylinder.

The body capacity of the C-5 is 5 tons, and the chassis weight, with cab, approximately 11,-500 lbs. The engine is rated at 105 B.H.P. at 2400 R.P.M. Gasoline or Diesel power is optional.

Ready-Mixed Aluminum Paint for Rusted Fence

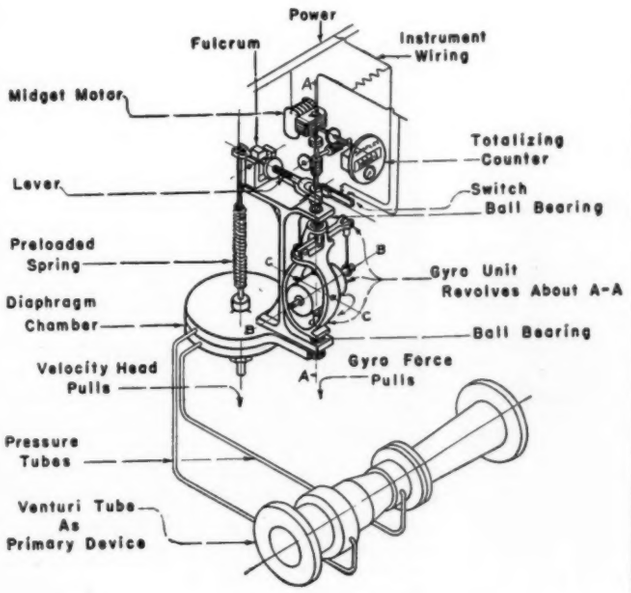
The Skybryte Company of Cleveland has announced a new ready-mixed aluminum paint, Fence-Bond, specially formulated for painting rusted chain link fence without removing the rust.

The base oils are of the penetrating type which creep into all joints and contact points, sealing the rust against further corrosive action. This paint is designed to dry from the "outside", retaining elasticity to withstand the movement of the joints without chipping. It may be applied with brushes or spray gun.

The pigment is Alcoa Albron Paste mixed at the factory under controlled conditions. This is said to insure better dispersion of the metal particles and result in a brilliant silvery durable finish.

The Simplex Gyrometer

A new piece of equipment, utilizing the gyroscopic principle, for the control or measurement of liquids and gases. It is available as a device for integrating flows in any pipe or main containing a Venturi tube, nozzle or orifice, or pitot tube, when located at any reasonable distance from the pipe. The use of the gyro permits greatest accuracy over a wider range of flow. Described in Bulletin 120. Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.



Parts arrangement of the gyrometer for the better control and measurement of liquids and gases.

Readers' Service Department

These helpful booklets are FREE. Write to the firm whose name is given, mentioning PUBLIC WORKS, or to this magazine.

(Continued from page 62)

also Jetting, Caisson, Road Pumps, recently issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

123. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

124. 16 - page illustrated bulletin, SP-37, describes and illustrates complete C. H. & E. line of self-priming centrifugal pumps from 1½" to 8", including lightweight models for easy portability. C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

Retaining Walls

126. Charts showing the design of cellular or bin-type metal retaining walls, helpful suggestions on their use for stabilizing slopes, preventing stream encroachment, and solving problems of limited right of way, and construction details are given in a 16-page bulletin entitled, "ARMCO Bin-Type Retaining Walls." It is published by the Armco Mfrs. Association, Middletown, Ohio, and member companies. Ask for Bulletin H-37.

Road Building and Maintenace

127. See road work as it was done in the 1890's and as it can be done by a full line of this year's road building equipment. See, in this new action picture book, the first reversible roller, 1893 World's Fair Award Grader and how methods have changed. Attractive new booklet AD-1796 recently issued by The Austin-Western Road Machinery Co., Aurora, Ill.

128. Motor Patrol Graders for road maintenance, road widening and road building, a complete line offering choice of weight, power, final drive and special equipment to exactly fit the job. Action pictures and full details are in catalog 200 issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Rollers

130. New bulletin describing in detail the new Huber Road Rollers will be sent promptly on request by the Huber Mfg. Co., Marion, Ohio.

132. "The Buffalo-Springfield line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog issued by the Buffalo-Springfield Roller Co., Springfield, Ohio."

Shovels, Cranes and Excavators

145. The Austin-Western-Badger, a fully convertible ½ yard crawler shovel, made by The Austin-Western Road Machinery Co., No. A-5 Aurora, Ill., is fully described and illustrated in their Bulletin No. AD-1683.

146. New catalog picturing the detailed construction of Osgood "Chief" power shovel and illustrating it as shovel, clamshell, dragline, crane and piledriver. Write The Osgood Co., Marion, Ohio, for your copy.

Soil Stabilization

150. "High-Service, Low Cost Roads" is one of the newer booklets using an effective combination of picture and text to set forth the principles and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated. 34 pages. Sent by Solvay Sales Corp., 40 Rector St., New York, N. Y.

155. "Better Bases for Better Roads" is a useful new booklet describing and illustrating the use of calcium chloride stabilized graded aggregate mixtures for pavement bases. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

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Readers' Service Department

(Continued from page 63)

Street and Paving Maintenance

Asphalt Heaters

198. Illustrated Bulletins 15 to 20 describe Mohawk Oil Burning Torches; "Hot-stuf" Tar and Asphalt Heaters; Portable Trailer Tool Boxes; Pouring Pots and other equipment for street and highway maintenance, roofing, pipe coating, water proofing, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

202. The maintenance of all types of roads and streets is the subject of this 52 page booklet which will be sent on request by The Barrett Co., 40 Rector Street, New York, N. Y.

Dust Control

210. "How to Maintain Roads with Dowflake" is a new 58 page illustrated booklet of information on stabilized road construction. Includes specifications and several pages of reference tables from an engineer's notebook. Issued by Dow Chemical Co., Midland, Mich.

211. A complete booklet on dust control titled, "Dust Control and Road Stabilization," describes the use of Columbia Calcium Chloride for dust control purposes and stabilization of roads. Sent on request by The Columbia Alkali Corp., Barberton, Ohio.

Sanders

270. Galion's new, inexpensive sander for quickly spreading sand, stone dust, cinders, chips, rock salt, calcium chloride, etc., is described and illustrated in a new circular which will be sent on request by Galion Iron Works & Mfg. Co., Galion, Ohio.

Street Markers

295. A new combination highway and street traffic marker and paint sprayer in an 8-page folder issued by Meili-Blumberg Corp., New Holstein, Wis. It is rugged, speedy, easy to operate, stripes straight or curved lines perfectly. Before buying a traffic marker be sure to send for this folder.

Snow Fighting

Plows

349. "Frink V Type Sno-Plows" is a 24 page catalog fully illustrating and describing 8 models of V Type Sno-Plows for motor trucks from 1½ up to 10 tons capacity, 16 models of Frink Leveling Wings, the Frink Hand Hydraulic Control and the latest Frink Selective Power Hydraulic Control. Data are given for selecting the proper size V plow and wing for any truck. Issued by Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Features, specifications and method of attaching. Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

Sanitary Engineering

Anaylsis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use," is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Activation and Aeration

375. This concise folder No. 1294 describes "Straightline Aerators" for activated sludge treatment; combines these features: 1, rapid circulation in the tanks; 2, exposure of large surfaces, hastened oxidation and bacteriological growth. Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

HOW TO ORDER: These booklets are FREE. Write to the firm whose name is given, mentioning PUBLIC WORKS, or to this magazine.

This sign will not blow over, is durable, attractive and highly visible, 45½ inches high, weighs 28 pounds. Descriptive folder from Industrial Products Co., 800 W. Somerset St., Philadelphia, Pa.

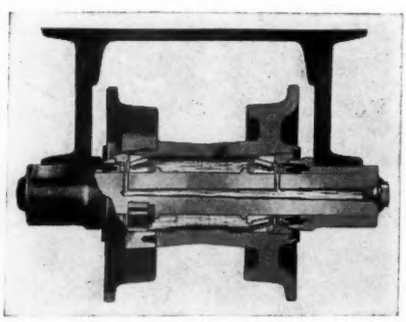
Eisner Appointed Chief Engineer of Clay Pipe Ass'n

Benjamin Eisner, who as chief sanitary engineer of the World's Fair, has been responsible for laying out and constructing the water and sewerage systems there, has been appointed chief engineer of the Clay Sewer Pipe Ass'n of Pittsburgh, Pa. Mr. Eisner has had a broad experience in engineering; he is known to readers of PUBLIC WORKS, also, as one of the foremost *Timewasting* experts, solving some of those most difficult problems that have appeared on page 7 of the various issues of this magazine.

Harry R. Hayes, former commissioner and city engineer of Utica, N. Y., has been appointed promotion engineer for the association to cover New York state.

New England Sewage Works Association

The 10th annual convention of this association will be held at Toy Town Tavern, Winchendon, Mass., September 29 and 30. J. A. Muldoon, who is superintendent of sewage treatment plants at Bridgeport, Conn., will speak on "Fine Screening of Sewage." John Szymanski will present data from the New Britain plant, of which he is superintendent, and A. D. Weston will summarize recent work at Lawrence. There will also be a paper on the operation of the Leominster activated sludge plant by J. A. Tourigny. L. W. Van Kleeck, State Department of Health, Hartford, Conn., is secretary.



New design and tapered roller bearings reduce friction so that lubrication is needed only at 200-hour intervals on these Allis-Chalmers tractor tracks

Readers' Service Department

380. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Aerators for Sewage

381. New 24 page booklet, No. 6571 describes and illustrates the Dorrco Paddle Aerator and also the Turbo-Aerator. Also contains a discussion of the activated sludge method of treatment with much interesting data and illustrations, including a section of "Useful Information." Issued by The Dorr Co., 570 Lexington Ave., New York, N. Y.

Automatic Controls

382. Pressure and liquid levels controls will maintain water level in 50-ft. tank within 1 foot. Send for full information. Electric Controller & Mfg. Co., 2710 East 79th St., Cleveland, O.

Cleaning Sewers

383. Low cost, rapid and complete cleaning of sewers. Booklet on request. Champion Corp., Hammond, Ind.

Cast Iron Sewers

384. Cast Iron Pipe for Sewers. Cast Iron Pipe has beam strength, resistance to crushing stresses and infiltration-proof joints making it highly desirable for flow lines, force mains, submarine lines, outfalls and sewage treatment plants. For specifications write U. S. Pipe and Foundry Company, Burlington, N. J.

Chemical Treatment

385. A handbook on the application of chlorine and iron salts in sewerage treatment. Tech. Publication 177. Wallace & Tiernan Co., Inc., Newark, N. J.

Diesel Engines

386. Write Dept. 118, Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago, Ill., for data on how the installation of F-M diesels has lowered taxes and made it possible for many communitines to pay for their improvements out of municipal power plant earnings.

Feeders, Chlorine, Amonia and Chemical

387. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from %Proportioneers, Inc.% 96 Codding St., Providence, R. I.

388. Chemical Feed Machines. Description, principles of operation; data on installation. E. W. Bacharach & Co., Rialto Building, Kansas City, Mo.

Filter Plant Controllers

389. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Flow Meters

391. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Garbage Incineration

392. Send for full information about the Decarie Suspended Basket-Grate Garbage Incinerator which solves the garbage disposal problem of any city economically and with a minimum of space. Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

Manhole Covers and Inlets

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjust-

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Readers' Service Department

(Continued from page 64)

able curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Concrete

409. Two excellent booklets, 12 and 16 pps., describe manufacture and installation of reinforced concrete pipe for gravity and pressure lines for sewage and storm drainage. Lock Joint Pipe Co., Ampere, N. J.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office, Memphis, Tenn.

Pumping Engines

424. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Rustproofing, Electric

427. No painting costs. Current from special electrodes removes all corrosion and prevents rusting. Informative literature on request. Electro Rustproofing Co., 38 N. Jefferson St., Dayton, Ohio.

Screens, Sewage

428. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago Ill.

Sewers

429. "ARMCO Sewers" is the title of a 48-page booklet describing the structural and other advantages of ARMCO Ingot Iron, Paved Invert and Asbestos-Bonded pipe for storm and sanitary sewers. Design data and large charts will be found helpful by engineers engaged in the design or construction of sewers. Copies will be sent on request by the Armco Culvert Mfrs. Association, Middletown, Ohio, or its associated member companies.

Meter Setting and Testing

430. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co. Wabash, Ind.

Rainfall Measurement

432. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Standard recorders for rain, snow and water level. Julien P. Friez & Sons, Baltimore, Md.

Small Septic Tanks

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets issued by San-Equip Inc., 700 Brighton Ave., Syracuse, N. Y.

Sludge Drying and Incineration

439. The five basic steps of: sludge preparation; flash drying; incineration; deodorization; and dust collection are explained in a new 24 page booklet, No. 6781 issued by The Dorr Company, 570 Lexington Ave., New York, N. Y., sales representatives for the C-E Raymond system of sludge drying and incineration.

Sewage Treatment:

One of the publications we look forward to getting is the report of the Ohio Conference on Sewage Treatment. The 1938 report, just out, contains a number of excellent papers, including: Activated Sludge Bulking, Aero-Chlorination for Grease Removal, Five Years of Sludge Digestion Studies at Cleveland, Gas Engine Operation at Toledo, A Symposium on Mechanical Filtration of Sludge and plenty of other excellent papers. The Conference finances publication of this and has no income from it other than from selling it. $1.25 per copy. Bruce McDill, Secretary, 302 State Office Bldg., Columbus, Ohio.

Municipal Lighting Plants:

This is the 6th, 1939, edition of an electric rate book showing the operating record of earnings, output, rates, revenues, valuation and other information on the use and cost of electricity in more than 700 municipally owned plants. 350 pp. $5. Burns & McDonnel Engrg. Co., Kansas City, Mo.

Engineers' Yearbook:

The American Public Works Association has published its annual yearbook and review of the field for 1939. It covers the public works field—highways, streets, sewerage and sewage treatment, refuse disposal and water supply and purification. 457 pp. $3.50. American Public Works Ass'n., 1313 East 60th St., Chicago, Ill.

Cleveland Tractor Publication

"Cletrac Facts," in its August issue, carries an interesting story of its new personalities and describes some of the new equipment. A note regarding the election of H. P. Mee appeared in the June issue of PUBLIC WORKS. W. Ellzey Brown has been appointed vice president in charge of sales, service and advertising; W. E. Miles is in charge of industrial and government sales. Henry Leisenheimer is vice president in charge of export, J. G. Heaslet is vice president in charge of engineering and manufacture; and E. M. Bell is treasurer. New Cletrac equipment recently announced has been described in preceding issues. *Cletrac Facts* is appearing in a new form also.

New York State Sewage Works Ass'n

The next meeting of the NYSSWA will be held at the Olean House, Olean, N. Y., Oct. 6 and 7. In addition to papers and discussions, there will be a display of Operators' gadgets. A. S. Bedell is secretary.

Readers' Service Department

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 216P East 45th St., N. Y.

444. A new booklet "Essential Factors in the Design and Layout of Swimming Pool Systems," with data on filtration equipment, fittings, solution feeders, accessories, etc., is available from Everson Manufacturing Co., 213 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

447. "Painting Swimming Pools," an interesting booklet by Dr. A. F. Pistor, covers the subject thoroughly, discussing objectively the relative merits of the different types of coatings recommended for that purpose. Write Inertol Co., 401 Broadway, New York, N. Y.

Taste and Odor Control

448. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a booklet issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 77 pages, tables, illustrations and usable data.

Treatment

450. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

451. "Soft Water for Your Community," tells by means of many interesting pictures and text the advantages of soft water to any community. Ask for a copy from The Permutit Co., Dept. G4, 330 West 42nd St., New York, N. Y.

454. New 16-page illustrated catalog No. 1742 on Straightline Collectors for the efficient, continuous removal of sludge from rectangular tanks at sewage and water plants. Contains layout drawings, installation pictures, and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.

460. This new 145 page illustrated chemical products book contains 55 pages of Tables, Factors and valuable Reference Data. Issued by General Chemical Co., 40 Rector St., New York, N. Y.

461. Ferrisul for Water and Sewage Treatment. Handy booklet describing Ferrisul and telling how it is used. Merrimac Chemical Div., Everett Station, Boston, Mass.

Valves and Hydrants

470. Complete booklet with much worthwhile water works data describes fully Ludlow hydrants and valves. Sent on request. Ludlow Valve Mfg. Co., Troy, N. Y.

Water Works Operating Practices

490. "Important Factors in Coagulation" is an excellent review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.

HOW TO ORDER

To obtain any of these booklets without obligation, send a post card to the firm whose name and address are given in the description and MENTION PUBLIC WORKS MAGAZINE. Or, if you prefer, send your request to Readers' Service Dept., PUBLIC WORKS, 304 East 45th St., New York, N. Y.

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Earth Moving in Highway Contruction

Some time ago, Frank Nikirk put out an excellent paper on "Tools and Equipment for Earth Moving in Highway Construction." This has been reprinted as a 16-page illustrated booklet. It is full of sound and practical data with information on economical hauling ranges of various types of equipment. A limited number of copies are available. Sent on request to Caterpillar Tractor Co., Peoria, Ill.

Secondary Crushing:

Since it is the big job today to produce enough small stone, this publication is needed. Tells how to select the proper size and kind of roll crusher for your job; power requirements; speed of operation; percentage of each size of stone; and lots of other data. Ask for "Facts About Secondary Crushing." O. J. Ellertson, Pioneer Engrg. Works, Inc., Minneapolis, Minn.

Working in the Dry:

This is a 92-page book written around the many uses of the well-point system for dewatering any wet soil and stabilizing and preventing mass movement during excavation. But it goes farther than that. Every engineer will find it valuable. Moretrench Corp., 90 West St., New York, N. Y.

Building Maintenance:

The second edition of this text; 56 pages; illustrated. It is most complete—covering everything from the cellar to the roof—and filled with valuable suggestions and directions. Sent on request to Flexrock Co., 2301 Manning St., Philadelphia, Pa.

Bathing Places:

Report of the Joint Committee on bathing places, including swimming pools. Conference of State Sanitary Engineers and American Public Health Assn. Available from U. S. Public Health Service, Washington, D. C.

Milk Sanitation Rating:

Methods of making milk sanitation ratings of milk sheds. A reprint from Public Health Reports. 14 pages. No charge. U. S. Public Health Service, Washington, D. C. Data prepared by Leslie Frank, A. W. Fuchs and W. N. Dashiell.

Highway Illumination:

This is the report of the Safe Highways Committee of the ARBA, which was presented at the 36th annual meeting. We believe it will be sent on request to the American Road Builders' Ass'n., Washington, D. C. Ask for Bulletin No. 57.

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